U. S. DEPARTMENT OF AGRICULTURE

OFFICE OF EXPERIMENT STATIONS

EXPERIMENT STATION

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VOLUME V, 1893-1894

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EXPERIMENT STATION RECORD.

VOL. V. No. 1.

Mr. A. W. Harris has resigned the directorship of this Office to assume the presidency of the Maine State college. Mr. A. C. True, formerly assistant director, has been appointed to succeed him. The editorial force has been reorganized in the direction of greater specialization of work. Arrangements have been made to give more attention to the bibliography of agricultural science. In the present volume of the Record, as heretofore, the aim will be to present, in brief, the chief features of progress in agriculture investigation at home and abroad.

The investigations on food stuffs thus far made by the stations in this country have related almost exclusively to the improvement of the quality and quantity of these agricultural products, and to their use for feeding the domestic animals. It is very desirable that parallel researches should be conducted with reference to the best ways of utilizing these products for the food of man. There is, moreover, great necessity for additional studies with a view to improving the methods of inquiry, and to adapting scientific information to practical ends. Additional interest in this subject has recently been excited by an article by Hon. Edward Atkinson, of Massachusetts, entitled, "Suggestions for the Establishment of Food Laboratories in Connection with the Agricultural Experiment Stations," which was published as Bulletin No. 17 of this Office. In view of the importance of the subject and the urgent need for addditional information before further original investigations are undertaken by the stations, this Office has been authorized to prepare a treatise on the methods of food investigation, with a résumé of the results already attained and a bibliography of the subject. This work will be in charge of Prof. W. O. Atwater, who has already done a large amount of work on foods.

No matter relating to the improvement of the conditions of farming has attracted greater attention within the past few months than the question how to secure good country roads. Active work in promoting the agitation of this problem has been done by the National League for Good Roads. The proceedings of the convention of this organization, held in Washington, D. C., in January, 1893, were published as Bulletin No. 16 of this Office. An appropriation made by Congress to enable the Secretary of Agriculture to aid in the diffusion of information on the best methods of road-making is available during the present fiscal year. General Roy Stone, formerly vice-president and acting secretary of the National League for Good Roads, has been put in charge of this work.

The Belgian Government has taken steps to secure a series of reliable works on agriculture and closely allied subjects, which shall present these subjects in the light of the most recent discoveries of science. A decree of the King of Belgium recently published * looks to the creation of a national library of agriculture. This library is to consist of twenty-two works, covering most of the subjects of importance to the Belgian farmer. Prizes, ranging from 750 to 1,500 francs, are offered for these several works.

The following is a catalogue of the subjects to be treated: (1) The practical theories of meteorology and agricultural climatology; (2) practical theories of agriculture, with special reference to the soil; (3) the anatomy and physiology of plants as related to practical agriculture; (4) cultivation; (5) manures; (6) special crops; (7) arboriculture, and the care of lowlands and swamps; (8) fungus diseases of cultivated plants; (9) anatomy and physiology of domestic animals from a practical standpoint; (10) the principles of the rational feeding of domestic animals; (11) breeding, choice, and selection of domestic animals; (12) hygiene of domestic animals, with the elementary principles of veterinary medicine, and sanitary police; (13) dairying; (14) insects injurious and useful to agriculture; (15) the small industries of the farm—poultry raising, apiculture, etc.; (16) agricultural industries—brewing, distilling, manufacture of sugar and vinegar; (17) theories of rural economy; (18) commerce and agriculture; (19) household economy on the farm; and (20) agricultural memorandum book, with condensed information on a multitude of subjects of interest to the farmer. The works on each of these subjects are to be limited to 150 pages.

Two larger works will be (1) an elementary and practical treatise on mathematics as used in agriculture, and (2) a manual of proximate and mineral analyses of plants. These may contain from 200 to 300 pages each.

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* Revue Agronomique, 1893, No. 1.

INVESTIGATIONS AT THE GRIGNON AGRICULTURAL EXPERIMENT STATION.

Emile Demoussy.

The experiment station connected with the Agricultural School at Grignon is in the department of Seine-et-Oise, one hour distant from Paris by rail. It was organized in 1875 by P. P. Dehérain, who has been the director since that time. The income from the Ministry of Agriculture is 5,500 francs per year.

The experiment field has an area of about 1 hectare (about 2½ acres). It is divided into 100 plats of 1 are (10 meters square), separated from one another by strips 50 centimeters wide.

In one part of the field is a small building in which are kept a weighing apparatus, implements for cultivating the land, samples of soils and seeds, and diagrams showing the crops obtained on the field.

Besides the experimental plats, there are 66 pots for the study of drainage waters from soils bearing no plants, and 20 vegetation boxes for the study of drainage waters from cultivated soils. These pots and boxes are described more in detail later on.

It was proposed at the outset that the investigations should bear not only on general subjects, such as the determination of the relative value of fertilizers, varieties of seeds, etc., but also on more scientific subjects, especially the causes of exhaustion of arable land when cultivated continuously without manure.

Reports of these experiments are published regularly in *Annales Agronomiques*. As those referring to the influence of different fertilizers on different crops, the influence of the variety, etc., apply especially to France, and more particularly to Northern France, the present article will be confined to those experiments which are of interest to every country.

EXHAUSTION OF ARABLE LAND BY CONTINUOUS CULTURE WITHOUT MANURE.

When the experiment field was first laid out it was thought advisable to repeat some of the experiments of Lawes and Gilbert. Therefore a few plats were chosen for continuous culture without manure. It is well known that under these conditions the yields decrease from year to year, but no satisfactory explanation of this fact has yet been given.

Why does the soil become exhausted? Can we, without applying manure, prevent, totally or partially, this exhaustion? What are the exact parts played by manures in maintaining the fertility of the soil?

If the experiments at Grignon have not fully answered these ques-

tions, they have thrown some light on the subject and helped to show in what direction work may be continued with chances of success.

The experiment plats were laid out in 1875 in a lucern field. The soil was at that time in excellent condition and bore good crops. At first the crops on the unmanured plats were as good as those on the manured ones, but they gradually began to fail, as can be seen in the following table in which the yield of a crop on a constantly unmanured plat is compared from year to year with that on a constantly manured plat:

Yields on manured and unmanured plats compared.

Year.	Kind of crop.	Plat 21, constantly unmanured.	Plat 37, constantly unmanured.	Plat 53, constantly unmanured.	Average yield on constantly manured plat.
			Kg.	*Kg.*	
1875	Potatoes (tubers)	295 hectoliters			350 hectoliters.
	Oats (grain)			6,950	6,950 kilos.
1876	Potatoes (tubers)	230 hectoliters			293 hectoliters.
	Fodder corn (green)		59,500		55,900 kilos.
	Oats (grain)			7,025	7,800 kilos.
1877	Potatoes (tubers)	255 hectoliters			283 hectoliters.
	Fodder corn (green)		54,000		70,500 kilos.
	Oats (grain)			4,150	5,390 kilos.
1878	Potatoes (tubers)	227 hectoliters			230 hectoliters.
	Fodder corn (green)		61,000		70,000 kilos.
	Oats (grain)			7,965	8,844 kilos.
1879	Potatoes (tubers)	224 hectoliters			246 hectoliters.
	Fodder corn (green)		22,000		77,000 kilos.
	Oats (grain)			4,900	6,657 kilos.
1880	Wheat (grain)	6,225 kilos			7,130 kilos.
	Fodder corn (green)		38,400		70,000 kilos.
	Oats (grain)			5,750	6,000 kilos.
1881	Wheat (grain)	3,690 kilos			5,450 kilos.
	Fodder corn (green)		58,000		79,000 kilos.
	Oats (grain)			3,440	4,200 kilos.
1882	Wheat (grain)	6,500 kilos			7,500 kilos.
	Fodder corn (green)		48,000		67,000 kilos.
	Oats (grain)			3,850	4,890 kilos.
1883	Wheat (grain)	3,070 kilos			4,270 kilos.
	Oats (grain)		6,350		9,320 kilos.
	Fodder corn (green)			64,000	88,000 kilos.
1884	Sugar beets			4,775	9,360 kilos.
1886	Oats (grain)		6,400		8,900 kilos.
1887	Sugar beets (roots)		13,900		40,000 kilos.
	Sugar beets			10,100	41,000 kilos.
1888	Scarlet clover	16,400 kilos			28,100 kilos.
	Corn afterwards	54,700 kilos			60,400 kilos.
	Oats (grain)		8,910		10,470 kilos.
	Oats			5,780	9,830 kilos.
1889	Wheat (grain)	3,550 kilos			9,590 kilos.
1890	Sugar beets (roots)	17,300 kilos			87,200 kilos.

The decrease in the yields is most striking for the crops of beets, fodder corn, and clover. For instance, in 1887 the crop of sugar beets on plat 37, constantly unmanured, weighed 13,900 kg. per hectare; on plat 53, also without manure since 1875, 10,100 kg.; while regularly manured plats bore 40,000 kg. In 1889, on a plat unmanured since 1875, the crop of scarlet clover, when freshly cut, weighed 3,600 kg., while the average crop on regularly manured plats was 15,000 kg. per hectare. In this same year the yield of red clover on a regularly manured plat was 8,800 kg. of hay; the constantly unmanured plats bore, one 3,200 kg., another 2,600 kg. We see also in the table that the corn crop begins to fail on plat 37, even in the first years of its culture. The soil that had received no manure since 1875 thus showed itself unable to yield good crops of clover or beets in 1887. To what causes can we assign this fact?

Although Liebig's theory of complete restitution is now wholly abandoned, yet we know that each crop removes from the soil a large amount of plant food. Has the soil lost elements necessary to plant life?

Starting with these ideas, investigations were made on the amounts of nitrogen, humus, and phosphoric acid lost from the soil.

LOSSES AND GAINS OF NITROGEN IN THE SOIL.

On the soil of Grignon the manures which prove most effective are those which contain nitrogen, particularly barnyard manure. It may be that the soil has lost much nitrogen, and the study of the proportion of nitrogen in the soil will lead us to an explanation of the exhaustion of the soil.

For years it has been known that growing leguminous plants improves the land so that it can afterwards bear good crops of wheat or beets, etc. We know to-day why it is so, but the facts were far from being so plain in 1875, and the reasons were still to be ascertained.

Losses and gains of nitrogen in unmanured soils in the field.—The field in which the experiment plats were laid out in 1875 was in good condition and bore good crops. It is in a valley near a small stream. The soil is clayey, siliceous, calcareous, and very permeable, and nitrifies with great facility, as a result of the last two properties. The subsoil is of white chalk and very permeable. Between the arable soil and the subsoil, however, there is a layer of earth whose composition is slightly different from that of the cultivated soil. The following are the results of analyses made in 1891:

Analysis of Grignon soil (manured) in 1891.

	Soil.	Subsoil.
	Grams per kg.	*Grams per kg.*
Total nitrogen	2.05	1.22
Total phosphoric acid	1.14	0.88
Phosphoric acid soluble in acetic acid	0.05	0.03
Calcium carbonate	5.32	1.24

Each year from three to six different crops are grown in the field; a large number of plats thus bear the same crop, so that the influence of manures may be seen. An idea of the nature of the crops may be had by a glance at the tables. At first the same crops were grown year after year on the same plats, but afterwards for most of the plats an irregular rotation system was adopted. On plats in good condition, regularly manured, the yields are generally very good.

When the crop has been removed and weighed an average sample is taken for analysis. The principal determinations made are dry matter and nitrogen for each kind of crop, starch for every crop of potatoes, and sugar for every crop of beets. Sometimes complete analyses of a plant are made when the object in view is the study of its development.

Different determinations are also made in the soil. For the present only the determination of nitrogen in the soil and in the crop will be discussed.

Until about 1887 the method used for this purpose was the soda-lime method, but now only the Kjeldahl method is employed, as being much easier and giving as accurate results for this kind of analyses.

Determinations of nitrogen were made in the soil of unmanured plats from time to time—at the beginning in 1875, afterwards in 1878, 1881, and 1889. The following tables give the results of these investigations on four plats:

Plats 5, 21, and 37, unmanured since 1875.

Plat 4 received 80,000 kg. of farmyard manure per year in 1875, 1876, and 1877; unmanured since 1877.

Gain or loss of nitrogen in soils bearing different crops.

No. of plat.	Year.	Kind of crop.	Nitrogen per kg. of soil.	Nitrogen per hectare. In soil to depth of 32 centimeters. After removal of crop.	Gained (+) or lost (—) by the soil.	Removed in crop.	Total gain (+) or loss (—).
			Grams.	*Kilos.*	*Kilos.*	*Kilos.*	*Kilos.*
No. 5	1874	Lucern	2.04	7,854			
	1875	Sugar beets					
	1876	do					
	1877	do					
	1878	Fodder corn	1.46	5,621			
	1875–1878				—2,233	400	—1,833
	1879	Sainfoin				106	
	1880	do				158	
	1881	do	1.50	5,775		87	
	1879–1881				+ 154	351	+ 505
	1882	Sainfoin				81	
	1883	do				166	
	1884	Grass *				23	
	1885	do	1.65	6,352		74	
	1882–1885				+ 577	344	+ 921
	1886	Grass				97	
	1887	do				58	
	1888	do	1.81	6,968		58	
	1886–1888				+ 616	213	+ 829
No. 21	1874	Lucern	2.04	7,854			
	1875	Potatoes					
	1876	do					
	1877	do	1.74	6,699			
	1875–1877				—1,155	198	— 957
	1878	Potatoes				69.0	
	1879	do				68.0	
	1880	Wheat				72.3	
	1881	do	1.69	6,506		45.1	
	1878–1881				— 193	254.4	+ 61.4
	1882	Wheat				69.6	
	1883	do				34.8	
	1884	Fodder corn				99.0	
	1885	Wheat				67.3	
	1886	Sugar beets				50.2	
	1887	Oats				63.9	
	1888	Clover † and corn	1.50	5,775		76.0	
	1882–1888				— 731	460.8	— 270.2
	1889	Wheat	1.52	5,852		65.3	
	1888, 1889				+ 77	65.3	+ 138.3

* Principally Italian rye grass (*Lolium italicum*).

† Scarlet clover, followed immediately by corn for fodder

Gain or loss of nitrogen in soils bearing different crops—Continued.

No. of plat.	Year.	Kind of crop.	Nitrogen per kilo of soil.	Nitrogen per hectare. In soil to depth of 32 centimeters. After removal of crop.	Gained (+) or lost (—) by the soil.	Removed in crop.	Total grain (+) or loss (—).
			Grams.	*Kg.*	*Kg.*	*Kg.*	*Kg.*
	1874	Lucern	2. 04	7, 854			
	1875	Fodder corn					
	1876	do					
	1877	do	1. 67	6. 434			
	1875–1877				—1, 420	289	—1, 131
	1878	Fodder corn				137	
	1879	do				50	
	1880	do				86	
	1881	do	1. 45	5, 582		130	
No. 37	1878–1881				— 852	403	— 449
	1882	Fodder corn				108. 0	
	1883	Oats				56. 1	
	1884	Sainfoin				194. 6	
	1885	Wheat				65. 9	
	1886	Oats				67. 6	
	1887	Sugar beets				34. 7	
	1888	Oats	1. 48	5, 698		82. 2	
	1882–1888				+ 116	579. 1	+ 795. 1
	1889	Clover	1. 53	5, 987		140	
	1888, 1889				+ 289	140	+ 429
	1874	Lucern	2. 04	7, 854			
	1875	Sugar beets					
	1876	do					
	1877	do					
	1878	Fodder corn	1. 50	5, 775			
	1875–1878				—2, 079	550	*—1, 529
	1879	Sainfoin				147	
	1880	do				215	
	1881	do	1. 65	6, 352		126	
No. 4	1879–1881				+ 577	588	+1, 165
	1882	Sainfoin				102	
	1883	do				238	
	1884	Grass †				52	
	1885	do	1. 77	6. 814		85	
	1882-1885				+ 462	477	+ 939
	1886	Grass				108	
	1887	do				75	
	1888	do	1. 98	7, 623		72	
	1886–1888				+ 809	255	+1, 064

* The total loss of nitrogen is really much larger, as during three succeeding years 80,000 kg. of farmyard manure were applied yearly; this corresponds to 400 kg. of nitrogen, making 1,200 kg. of the three years. The total loss should be 1,200 + 1,529, or 2,729 kg.

† *Lolium italicum.*

Let us first consider plat 5. At the end of 1874 the soil of the plat contained 2.04 grams of nitrogen per kg. (the proportion was the same for all the plats of the newly laid-out experiment field). In 1878, after having borne sugar beets and corn, the soil held only 1.46 grams of

nitrogen per kg. Afterwards the amount increased to 1.50 grams in 1881 after sainfoin, to 1.65 in 1885 after sainfoin and grass,* and to 1.81 grams in 1888 after grass.

Plat 37 shows a decrease up to 1881; it had been constantly in fodder corn. A slight gain was observed in 1888 and 1889, after various crops.

The amount of nitrogen constantly decreases on plat 21; but the decrease proves to be less and less, until in 1889 a slight gain is observed, there being 1.52 grams instead of 1.50 as in 1888.

Plat 4 received farmyard manure (80,000 kg. per hectare yearly) in 1875, 1876, and 1877, and has remained unmanured since. Despite the nitrogen furnished by the manure, the proportion of this element in the soil had fallen to 1.5 grams per kg. in 1875; but sainfoin and afterwards grass being sown, the amount of nitrogen gradually increased.

Of course it was at first natural to assume that these losses of nitrogen were due to exhaustion by the crop. To ascertain if such was the case this amount was calculated from the weight of the crop and its percentage of nitrogen, and the total amount of nitrogen present in the soil of one hectare to the depth of 32 centimeters. These figures showed the soil of one hectare to weigh 3,850 French tons, equal to 3,850,000 kg., or 8,475,000 English pounds. The tables give the total amount of nitrogen in the soil after the crop had been removed, in 1877, 1881, etc.; the nitrogen gained or lost by the soil; the amount of nitrogen taken up by the crop each year, and the sum for the period intervening between two analyses; and lastly the total gain or loss that the soil had undergone.

Consider, for instance, the case of plat 5. At the beginning of 1875 the total amount of nitrogen to a depth of 32 centimeters was 3,850,000 $\times$2.04 grams=7,854 kg. At the end of 1878 this amount was 3,850,000 $\times$1.46 grams=5,621 kg. Therefore the soil lost from 1875 to 1878 a total amount of nitrogen equal to 2,233 kg. During this period the crops removed 400 kg. of nitrogen. Thus the soil lost from other causes 1,833 kg. In 1881 the soil, containing 1.5 grams instead of 1.46 as in 1878, had gained 154 kg. of nitrogen. The crops having removed 351 kg., the total gain was 505 kg.

For this plat it appears that the loss of nitrogen by the soil was enormous during the first years when in sugar beets and corn, but afterwards, when planted in sainfoin, there was a gain of nitrogen. We know today that this is always the case when leguminous plants are grown, and we also understand the reason. We need not therefore dwell on this fact, but it is well to consider the figures. In 1884 the land was laid down in grass, consequently bore *Gramineæ*, and it still continues to

* In France the principal *Graminea* of grass lands is Italian rye grass (*Lolium italicum*).

gain nitrogen. Here we have no satisfactory explanation to give. From the experiments of Atwater, Hellriegel and Wilfarth, Schlösing, jr., and Laurent, we conclude that the *Gramineæ* do not fix free nitrogen. How, then, does the soil become richer despite the large quantities of nitrogen removed each year by the crops? Must we assign this gain to the *Algæ* of Schlösing and Laurent, or does the soil itself gain nitrogen? No answer can be given at present.

Precisely the same facts were observed for plat 4. Plat 21 lost nitrogen up to 1889. In 1881, if the soil itself lost 193 kg. of nitrogen, the crops removed 254; that is, there must have been a gain of 61 kg. This amount, however, is so small that we can not conclude that there was any marked effect due to the wheat crop of 1880 and 1881.

Plat 37 was slightly richer in 1888 than in 1881, although the crops removed large amounts of nitrogen; but we must not forget that the land was in sainfoin in 1884.

Summary of results.—A light soil like that of Grignon loses nitrogen when it bears such crops as potatoes, beets, and corn. The loss of nitrogen greatly exceeds the amount removed by the crops.

The soil gains nitrogen not only when it is in *Leguminosæ*—sainfoin, or clover—but also when the land is laid down in grass. We can not, as we have said, explain this last fact; but we may remark that the soil seems to gain nitrogen only when it is not disturbed, without inferring that this condition is necessary.

Since the losses of nitrogen are not due to the removal by the crops, it is necessary to inquire further regarding the causes of these losses.

LOSS OF NITROGEN FROM SOIL BY DRAINAGE.

We know that the nitrogenous matter of the soil, the humus, is constantly undergoing changes. Under the influence of microbes, and in the presence of alkaline substances like calcium carbonate, the humic matter is oxidized and transformed into nitrates. (It is believed that commonly the formation of ammonia precedes that of nitric acid). We know, furthermore, that nitrates are not retained by the soil, and that they are either absorbed by the plants or washed out by the drainage water.

Can nitrification be active enough to cause the soil to lose 1,500 or 1,800 kg. of nitrogen per hectare in four years? This amount was actually lost by some of the plats in the field experiments above described (plats 4 and 5, period extending from 1875 to 1878).

The study of nitrification in the soil of Grignon can not only answer this, but also throw light on other closely related questions.

The exhaustion of the soil may be due, not exclusively to the loss of nitrogen by the soil, but rather to diminution in the proportions of humus, a diminution bearing particularly on the nitrifiable matter. In other words, the humus remaining in the exhausted soil is perhaps unable to give sufficient amounts of nitric nitrogen to the plants, *i. e.*,

does not nitrify fast enough. On the other hand, humus retains water with great facility, and its presence is perhaps useful in keeping in the soil the amount of water necessary for the vigorous growth of plants. The results of the investigations on nitrification will enable us to discuss these two questions.

A last hypothesis may be advanced as to the part played by the humic matter; it is perhaps an essential food for certain plants. Of this we shall speak in a special chapter.

Experiments on bare soils.—These experiments on nitrification began in 1887, but on a very small scale. Samples of soil from different plats of the experiment field were placed in glass funnels and watered from time to time. The percolating water was analyzed in order to determine the amount of nitric nitrogen present. This method was, of course, unsatisfactory.

In 1889 the samples of soil were placed in large earthenware pots, glazed inside and outside. They hold about 60 kg. of soil and their surface corresponds to one sixty-thousandth of a hectare. About seventy experiments in these pots are now in operation.

In order that the conditions of the soil in these pots may resemble as closely as possible the conditions of the soil in the field, the pots are kept in the open air in a ditch, their surface being level with that of the field. They are wrapped in straw and sheltered from the sun's rays by wooden boards on two sides and by embankments on the other two.

They are supported on iron tripods, so that glass flasks may be placed under them to receive the drainage water. To determine the relation between rainfall and drainage a flat dish having exactly the same surface as the pots is placed alongside of them to collect the rainfall.

A large number of the pots are filled with soil from the experiment field, but from different plats. Some have soil from plat 5, in grass, unmanured since 1875; and some exhausted soil from plat 21 also constantly without manure; others have soil from good plats like 17 and 37; and, finally, a few pots have samples of soils from different parts of France. The soils of Wardrecques and Blaringhem come from the Pas-de-Calais, in the north of France. The Wardrecques soil bears exceedingly good crops when it is well manured; Blaringhem is also very good, but needs to be well drained. The two soils of Marmilhat and Palbost come from the Limagne of Auvergne, and are black, rich in humus, and very permeable. They can bear average crops for a long while without being manured. As to the Grignon soil, it is, as already stated, very permeable and bears good crops when properly manured.

In some pots 1 kg. of farmyard manure was added to see what changes would thus be brought about; others received the dark brown liquid obtained by leaching 1 kg. of manure with warm water, so that the soil thus received the nitrogen of the manure without having its physical properties distributed by a bulky material like straw. This is what we

have called liquid manure in the tables. In some cases this liquid was boiled with magnesia to expel all the ammonia it contained.

The following table gives a description of the nature and treatment of the soils used in the experiments:

Nature and treatment of soils used in pot experiments.

No. of pot.	Origin of the soil.	Condition of the soil before being taken from the field.	Time when the soil was taken from the field.	Treatment of the soil in the pots.		
				1889.	1890.	1891.
1	Grignon, plat 5	Grass land, unmanured since 1875.	March, 1891			Nothing.
2	Grignon, plat 17	Good soil, regularly manured.	....do			Do.
3	....do	....do	....do			Farmyard manure.
4	Grignon, plat 21	Exhausted soil, unmanured since 1875.	May, 1889	12 grams of ammonium sulphate.	Nothing. The ammoniacal nitrogen has disappeared.	
5	Grignon, plat 37	Exhausted soil, similar to 21; unmanured since 1875.	April, 1891			Farmyard manure.
6	....do	....do	....do			Liquid manure.
7	....do	....do	....do			Liquid manure without ammonia.
8	Wardrecques	Good soil, regularly manured.	March, 1890		Nothing	Nothing.
9	....do	....do	....do		...do	Farmyard manure.
10	Blaringhem	....do	....do		...do	Nothing.
11	Marmilhat	....do	....do		...do	Do.
12	....do	....do	....do		...do	Farmyard manure.
13	Palbost	....do	....do		...do	Nothing.
14	....do	....do	....do		...do	Farmyard manure.

Every time it rains the water in the shallow dish, which we may call the pluviometer, is collected and measured. A sample, 1 liter at most, is taken to the laboratory for analysis. The only interesting determination is that of nitric nitrogen, experience having shown that drainage waters contain but little potash, phosphoric acid, and organic nitrogen.

The results of experiments extending from March, 1891, to March, 1892, the third year of observation, are given below. In the two preceding years similar observations were made, but we prefer to state the latest results as being the most complete, referring the reader to *Annales Agronomiques* for the other experiments.

The most interesting figures obtained in fourteen experiments during the above period are given in the following tables:

Relation between rainfall and drainage in bare soils.

No. of pot.	Soil experimented with.	Manure applied in pot in March, 1891.	Drainage water, height in millimeters.				
			Spring.	Summer.	Autumn.	Winter.	Whole year.
1	Grignon, plat 5; grass land, unmanured since 1875.	None	80.0	51.0	53.6	104.0	288.6
2	Grignon, plat 17; regularly manured.	....do	67.1	54.2	46.8	99.0	277.1
3	Grignon, plat 17	Farmyard	81.4	70.2	61.4	102.0	315.0
4	Grignon, plat 21, exhausted soil; unmanured since 1875.	None	63.8	46.6	45.4	100.0	255.8
5	Grignon, plat 37, exhausted; unmanured since 1875.	Farmyard	27.0	69.4	58.7	122.0	277.1
6	Grignon, plat 37	Liquid manure	22.8	55.5	54.1	124.0	256.4
7	......do	Liquid manure, without ammonia.	23.1	52.5	54.9	114.0	244.5
8	Wardrecques	None	59.0	43.8	45.5	103.0	251.3
9	......do	Farmyard	60.5	46.6	47.5	105.0	259.6
10	Blaringhem	None	77.7	63.8	60.2	125.0	326.7
11	Marmilhat	....do	79.5	69.6	58.6	120.0	327.7
12	.....do	Farmyard	80.8	68.5	62.4	121.0	332.7
13	Palbost	None	93.4	89.6	65.8	125.0	373.7
14	......do	Farmyard	84.0	71.1	58.9	126.0	340.0
	Average		74.3	55.1	62.3	112.0	293.7
Rainfall in millimeters			176.2	170.7	91.7	125.0	563.7

Nitric nitrogen per cubic meter of drainage water from bare soils.

No. of pot.	Soil experimented with.	Manure applied in pot in March, 1891.	Nitric nitrogen per cubic meter of drainage water.				
			Spring.	Summer.	Autumn.	Winter.	Whole year.
			Grams.	*Grams.*	*Grams.*	*Grams.*	*Grams.*
1	Grignon, plat 5; grass land, unmanured since 1875.	None	29.1	36.0	51.3	13.6	31.1
2	Grignon, plat 17; regularly manured.	....do	58.6	46.6	98.0	15.6	51.7
3	Grignon, plat 17	Farmyard	104.6	64.6	104.6	19.0	68.4
4	Grignon, plat 21, exhausted soil; unmanured since 1875.	None	28.3	34.6	56.6	12.5	31.0
5	Grignon, plat 37, exhausted; unmanured since 1875.	Farmyard	76.0	68.0	92.0	19.7	57.0
6	Grignon, plat 37	Liquid manure	82.0	67.3	97.3	19.4	59.4
7	......do	Liquid manure without ammonia.	74.0	78.0	100.0	16.7	61.3
8	Wardrecques	None	28.6	20.6	64.6	13.5	33.0
9	......do	Farmyard	80.6	48.0	86.6	17.2	55.0
10	Blaringhem	None	33.0	41.3	68.6	15.7	39.0
11	Marmilhat	....do	19.0	24.6	30.0	12.2	18.9
12	......do	Farmyard	56.3	44.0	46.0	16.2	38.7
13	Palbost	None	13.0	19.3	31.3	9.5	17.6
14	......do	Farmyard	33.3	36.0	48.0	13.5	34.3
	Average		47.6	45.3	66.6	15.0	42.9

Nitric nitrogen in drainage water per hectare of bare soil.

No. of pot.	Soil experimented with.	Manure applied in pot in March, 1891.	Nitric nitrogen in drainage water from one hectare of soil.				
			Spring.	Summer.	Autumn.	Winter.	Whole year.
			Kg.	*Kg.*	*Kg.*	*Kg.*	*Kg.*
1	Grignon, plat 5; grass land, unmanured since 1875.	None	19.62	13.68	29.66	15.56	78.52
2	Grignon, plat 17; regularly manured.	....do	36.42	15.84	47.00	16.69	115.95
3	Grignon, plat 17	Farmyard	78.88	39.84	58.84	21.30	198.86
4	Grignon, plat 21, exhausted soil; unmanured since 1875.	None	18.54	12.30	29.36	14.50	74.70
5	Grignon, plat 37; exhausted; unmanured since 1875.	Farmyard	20.52	46.92	51.90	23.82	143.16
6	Grignon, plat 37	Liquid manure	18.66	36.54	50.64	28.30	130.14
7	......do	Liquid manure without ammonia.	17.10	39.00	52.26	19.38	127.74
8	Wardrecques	None	17.10	13.44	27.66	15.60	73.80
9	........do	Farmyard	48.48	20.46	42.10	19.44	130.48
10	Blaringhem	None	26.88	16.24	49.86	19.62	112.60
11	Marmilhat	....do	15.84	16.80	17.28	12.14	62.06
12	......do	Farmyard	44.52	22.92	34.20	19.92	121.56
13	Palbost	None	13.08	18.18	21.64	11.04	63.24
14	......do	Farmyard	36.96	15.96	36.42	17.10	106.44
	Average		29.37	23.51	39.20	18.17	110.25

[The essential features of these experiments as reported in *Annales Agronomiques* 18 (1892), pp. 273–299, are given in Experiment Station Record, vol. IV, p. 295, so that it seems desirable to repeat here only the author's general conclusions.—ED.]

Summary and conclusions.—(1) The ratio of rainfall to drainage for bare soils is very near unity in winter and about the same in autumn, but increases in spring and especially in summer. For the whole year 1891–'92 the drainage slightly exceeds half the rainfall.

(2) The ratio of rainfall to drainage is different for each soil. A soil where drainage has proved to be useful may easily lose the water it receives, but we must remember that the subsoil in this case is impermeable. Other soils easily retain water, but if the subsoil is a permeable white chalk it will suffer more from dryness than from excess of moisture. The nature of the subsoil determines the utility of drainage more, perhaps, than does the nature of the soil itself.

(3) In no case did farmyard manure exercise any perceptible influence on the drainage.

(4) Different soils, under the same conditions of temperature and moisture, lose by drainage different amounts of nitric nitrogen, in some cases twice as much as in others.

(5) A soil which in the first year of experimenting had given much nitric nitrogen lost very little during the second year. On the other hand, other soils, in which nitrification had been moderate the first year, lost as much in the second year as in the first, or even more. Therefore, the soils which contain the largest amount of easily nitrifiable nitrogenous matter are the most quickly exhausted.

(6) For the year 1891–'92 the drainage waters contained on an average 31.7 grams of nitric nitrogen per cubic meter, rising to 51.7 grams

for a well-manured* soil, and falling to 17.6 grams for a soil rich in humus.

(7) On applying to the soil a liberal amount of farmyard manure it was found that the nitric nitrogen in the drainage water was invariably increased, but not uniformly. This shows that the nature of the nitrifiable matter does not have a predominating influence on the amount of nitrogen washed out by the drainage water. In a year from one seventh to one fourth of the nitrogen of the manure was nitrified and washed away.

(8) For unmanured soils the loss of nitrogen by drainage is greatest in autumn, a little less in spring, and smallest in winter.

(9) The large amounts of nitrates lost in autumn, 40.6 kg. of nitrogen per hectare (average for the three years 1889–'92), corresponding to 250 kg. of sodium nitrate, show the necessity of autumn catch crops.

(10) The small amount of nitrates in the drainage of spring, which has amounted on the average for three years on unfertilized soils to 17.03 kg. of nitric nitrogen, suggests the wisdom of applying nitrate of soda at that season.

(11) For manured soils the drainage waters contain a large amount of nitrates in the spring, when the manure has recently been applied. It is possible that this fact is due to the easy nitrification of the ammonia compounds of the manure.

(12) During the year 1891–'92, of 100 parts of nitrogen in the manure applied, 10 parts were nitrified in spring, 3 in summer, 5 in autumn, and 2 in winter—in all, 20 per cent.

(13) The first rains of autumn furnish drainage waters richest in nitrates. At that time the proportion was 79 grams of nitrogen per cubic meter; for manured soils the proportion may rise to 130 grams. The water is poorest in winter, containing only 10 grams per cubic meter in December and January.

Nitrification in soils bearing crops.—We have seen in the preceding chapter how nitrification goes on in fallow soils, manured or unmanured, and we have an idea of the amounts of nitrogen lost by a soil under the conditions described.

Practically a soil is not always bare; during a great part of the year it is covered by plants. It is to be assumed that cultivated soils will lose by drainage less nitric nitrogen than bare soils, for two reasons: (1) The crop will take up some of the nitrogen nitrified, and (2) much of the water which falls on the ground will be evaporated by the plants, and less will be left to wash away the nitrates.

It is of the utmost interest to know what amounts of nitrogen are thus lost by cultivated soils, and also to know what fraction of the nitrogen of the manure goes to the plants and what fraction is lost by drainage.

*Manured in the field before being experimented with in the pot.

In 1889, when the experiments with soils in pots were first begun, a large number of these were sown with different plants. It was soon found that only certain kinds of crops could be well cultivated. Small plants like rye grass or clover did well, but beets, corn, wheat, and oats were always rather sickly. It is probable that in summer the soil of the pot becomes much too hot (the temperature is often 4° higher in the soil of the pot than in that of the neighboring field), and this may be injurious to the plants. Moreover, the soil dries very quickly because of the high temperature, and especially because there is no subsoil which may yield water to the soil. As a consequence, nitrification is not the same as in the field. Therefore the results recorded for the pot experiments do not represent what goes on in the soil of Grignon, but show us what nitrification might be in a climate warmer and drier than that of the environs of Paris.

In 1890 and 1891 attempts were again made to grow beets, hemp, etc., in pots, but without great success. At length in autumn, 1891, twenty vegetation boxes better adapted to the growth of larger plants were made and experiments were commenced.

[A description of these boxes, together with a full report on the results obtained in the experiments, will be found in an article in *Annales Agronomiques*, 19 (1893), pp. 69–89, an abstract of which is given in Experiment Station Record, vol IV, p. 682. The author's summary of results is given below.—ED.]

Summary of results.—The results bring out the fact that the amounts of nitrogen per cubic meter of drainage water vary within narrow limits, except in case of sugar beets. On the other hand, the figures showing the total amount of nitrogen washed out in the drainage differ widely. The losses per hectare vary according to the kind of crop, and while the water from a bare soil does not contain much more nitrogen per cubic meter than the water from a soil bearing wheat, oats, or beets for seed, the total losses are much greater for the bare soils than for the cultivated soils. This is a fact which we wish to emphasize. The larger losses are due to the larger amounts of water which percolate through the soil. When a crop is luxuriant, and especially when it remains on the soil late in the season, it evaporates a large quantity of water, and the losses by drainage are consequently small. When the crop is sickly and when its period of growth is short the losses are very large. To leave soils bare in autumn is dangerous and exhausting. In the next chapter the cultivation of catch crops to reduce the losses from these sources is considered at length.

AUTUMN CATCH CROPS FOR RETAINING THE NITRATES WASHED OUT BY DRAINAGE WATER.

We have seen that large amounts of nitrogen are lost in the drainage from bare soils and that these losses are considerably diminished when the soil is covered by plants. Generally the soil is bare in

autumn, and as the soil is then rich in nitrates the rains which usually fall at that period are the cause of great losses.

The following experiments were made before those recorded in the preceding chapter, but it is perhaps better, after having shown what are the losses from bare and from cultivated soils, to show how these losses can be prevented.

The plants used for catch crops must have a rapid growth, so as to cover the ground in a short time; they must have a particular liking for nitrates, and the seed must be cheap. The best seem to be mustard, rape, colza, vetches, and clover.

The experiments were made on crops growing in the large pots already described. The following table gives the drainage water and the loss of nitrogen for each pot, and the calculated loss per hectare:

Pot experiments on catch crops, November 1, 1890, to February 1, 1891.

Summer crops.	Autumn crops.	Drainage water from each pot.	Nitrogen lost.	
			By each pot.	Per hectare.
		Liters.	*Mg.*	*Kg.*
Sugar beets	None	8.970	172	10.34
Fodder corn	...do	9.264	302	18.15
Oats	Colza	9.868	32	1.94
Hemp	None	9.716	222	13.33
Peas	Rape	7.888	54	3.28
Rye grass	Rye grass	8.156	44	2.67
Clover	Clover	9.512	48	2.90

About the same amount of water percolated through each pot. This must be assigned to the fact that the crops were not very luxuriant, the weather being rather dry, and consequently but little water was evaporated. Although the cultivated soils yielded the same amount of drainage water as the bare soils, comparatively little (about one fifth as much on the average) of the nitrates was lost, being retained by the plants. We may say that the catch crops have saved about 12 kg. of nitrogen per hectare; this is stored in the plants which are turned into the soil in February. The crops which follow thus find some nitrogen readily available. These experiments, however, are not very satisfactory. They show very well the part played by catch crops; but a saving of only 12 kg. of nitrogen (corresponding to 80 kg. of sodium nitrate) is scarcely worth the cost of seed and trouble of sowing and turning in the crop. The unfavorable results were due to the dry weather of the autumn of 1890 and the severe cold of the winter of 1890–'91. Very little water percolated through the earth, so that the bare soils lost but little nitrogen. The losses would certainly have been greater in a rainy season.

In the autumn of 1891 three pots were left without plants, five were sown to vetches, and five to mustard and clover. Vetches were chosen because they assimilate free nitrogen and are thus agents not only for retaining the nitrates but also for enriching the soil. The same may be

said of clover. Mustard was sown at the same time. This plant grows rapidly and easily takes up nitric nitrogen.

The vetch crops were turned into the ground at the end of the autumn of 1891, and the clover at the beginning of March, 1892.

The following table gives the results of these experiments, the figures representing the amounts of nitric nitrogen washed out of one hectare of soil:

Pot experiments on catch crops, autumn, 1891, to summer, 1892.

Crop.	Plat.	Nitrogen washed out of one hectare of soil during— Autumn, 1891.	Winter, 1891-'92.	Spring and summer, 1892.	Remarks.
		Kg.	Kg.	Kg.	
None	1	35.5	21.5	62.0	
Do	2	52.0	31.0	55.1	
Do	3	23.0	14.5	58.0	
Vetches	4	0	3.0	121.5	The vetches were turned under at the end of the autumn.
Do	5	0	4.0	88.0	
Do	6	0	6.0	86.5	
Do	7	0	4.5	84.0	
Do	8	0	2.0	80.5	
Mustard and clover	9	0	7.5	70.5	The mustard died during the autumn but the clover remained and was turned under in March, 1892.
Do	10	0	7.0	83.0	
Do	11	2.0	8.1	116.0	
Do	12	7.0	8.0	84.5	
Do	13	3.0	7.1	....	

First of all we notice that in autumn no nitrates were lost from seven pots out of the ten bearing plants, because there was no drainage water. The vetch crops proved to be really protection crops. The vetches were very luxuriant and evaporated all the water they received; consequently no losses occurred. On the soil bearing mustard and clover a little water went to the drains, but the losses were very small.

At the end of autumn the vetch crop was turned under and incorporated with the soil. Although in winter there were no plants for evaporating water, the losses were still smaller than for the bare soils; this was because the soils which had received green manures were not saturated with water as were the bare soils.

The clover remained on the ground during the winter, and was turned under in March.

Looking now at the figures representing the loss in the spring and summer of 1892, we see that the soils which received green manure lost very large quantities of nitric nitrogen; the nitrogen retained in the autumn reappeared in the spring. The plants decayed and the nitrogen was set free once more. This is particularly interesting, because in the ordinary conditions at that time of the year the soil is covered by new plants which can thus easily find the nitric nitrogen they need during the first period of their life.

We thus see how profitable green manuring is. Not only the nitrates are not lost in autumn and winter, but are easily available in the spring for the new crops which cover the ground. Instead of providing the

crops of 1892 with 50 or 60 kg. of nitric nitrogen per hectare, as do the soils without green manures, those that have been in vetches now supply 80 to 120 kg. of nitric nitrogen and those in clover 70 to 115. Green manuring may be particularly recommended in countries where practical difficulties prevent the use of farmyard or other manures.

HUMIC MATTER AS A NECESSARY FOOD FOR CERTAIN PLANTS.

In the preceding pages we have seen how the nitrogen gradually disappears from the soil; that though the amount of nitrates formed decreases every year, still crops can find the nitric nitrogen necessary for their growth. But it is not the nitrogen alone which disappears; the nitrogenous matter of the soil, the humus, is slowly burnt and the proportion of organic carbon decreases also. Barnyard manure always gives very good results at Grignon. When we consider that this manure is very rich in humic matter, we are inclined to assume that the sterility of an unmanured soil may perhaps be due to its poverty in humus.

The following table gives the amounts of nitrogen and of organic carbon per kg. in the soil from different plats in 1878 and 1888, also the ratio of the nitrogen to the carbon.

Plats experimented on.	Nitrogen per kilo of soil.			Carbon per kg. of soil.			Ratio of carbon to nitrogen.	
	1878.	1888.	Difference.	1878.	1888.	Difference.	1878.	1888.
	Grams.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*		
37. Constantly unmanured	1.67	1.48	0.19	15.19	7.30	7.89	9.0	4.9
21. Constantly unmanured	1.74	1.50	0.24	16.30	7.30	9.00	9.3	4.8
49. Regularly manured	2.00	1.90	0.10	15.20	16.10	+ 0.90	7.6	8.4
32. Regularly manured	2.00	1.86	0.14	16.60	16.00	— 0.60	8.3	8.5

The different plats have lost but little nitrogen from 1878 to 1888. While the proportion of carbon is nearly the same in 1888 as in 1878 for the regularly manured plats, the unmanured ones have lost about half their carbon. We can now say with certainty that one effect of barnyard manure is to maintain a certain amount of organic carbon in the soil. Looking at the last two columns we see that the ratio of carbon to nitrogen was in 1888 about half what it was in 1878 for the unmanured plats; it did not change for the manured plats. Thus the organic matter of the soil underwent considerable change in ten years.

The ratio of carbon to nitrogen is different for different soils. Warington found it to be 12 for a regularly manured soil at Rothamsted, and 9.4 for a soil receiving ammonia salts. The light soil of Grignon seems to lose its carbon more rapidly than the rather heavy soil of Rothamsted, but the general results are the same.

The constantly unmanured plats had become unable to bear good crops of beets or clover, as we have seen. For certain plants the lack of fertility can be counterbalanced by the use of farmyard manure, but

the same can not be done for the *Leguminosæ*. The clover crop is not improved when potassium chloride or superphosphates are applied. We are hence led to believe that the partial sterility of this soil is due to the absence or deficiency of humus. We observe, however, that for oats the soil did not seem to be exhausted; the average crop of oats (grain) on a regularly manured plat weighed 3,600 kg., while a constantly unmanured plat bore 2,800 kg.

We can put forward several explanations of the part played by the humic matter of the soil:

(1) As a nitrogenous matter it gives rise to nitrates, which are an essential food for plants; if the amount of this matter decreases, less nitrates are formed and consequently the plants do not find enough food. We have seen that this is not the case, that generally the amount of nitrates formed in the unmanured soil is quite sufficient.

(2) Humus quite resembles a sponge in easily retaining water; it is, therefore, natural to assume that the loss of humus involves a drying up of the soil, thus diminishing the crop.

Determinations of the percentages of water in the soils in the field, and a consideration of the quantities of drainage water from normal and from exhausted soils showed no difference between the two kinds of soil as to their retentive power for water.

(3) By oxidation humus gives rise to carbon dioxide. An aqueous solution of this can dissolve certain substances which are important as plant-food, such as phosphates, calcium, and magnesium compounds, which are insoluble in pure water. If the soil is lacking in humus the plants will therefore find less soluble mineral food.

Gases were extracted from the soil of different plats several times, but the proportion of carbonic acid gas was always found to be nearly the same—a little over 1 gram for 100 liters of air. There seems to be no relation between the proportion of humus in a soil and the amount of carbonic acid it contains.

(4) Several French physiologists claim that the humic matter of the soil is not a food for plants, but others, and particularly German physiologists, think otherwise. We believe that certain plants, like the *Gramineæ*, do not need this substance at all, and that others, like the legumes, can not live without it. While some substances may not be food for plants in general, they may be food for certain kinds of plants.

In 1889 the following experiment was instituted to see if the lack of humus was really the cause of the observed sterility of the unmanured soils. Sugar beets which had yielded very poor crops on the unmanured plats were experimented on.

One of the large pots already described was filled with earth from plat 49, rich in organic matter. Another pot received soil from plat 53, exhausted by continuous culture without manure. It received 6 grams each of sodium nitrate, muriate of potash, and superphosphate,

corresponding to 360 kg. of each fertilizer per hectare—a considerable quantity.

The seeds were sown rather late (June 25). On July 17 several small plants were rooted up so as to leave only one beet in each pot.

Four small beets on the poor soil weighed 2.51 grams (0.63 gram each). Three beets from the normal soil weighed together 6.78 grams (2.26 grams each). Thus even at the beginning the regularly manured soil showed its superiority. The two remaining beets were harvested October 25. They were weighed and the amount of sugar was determined for each root.

Weight and sugar content of sugar beets grown on soils rich and poor in humus.

	A. Normal soil rich in humus.	B. Exhausted soil with mineral fertilizers.
	Grams.	*Grams.*
Weight of the whole plant	730.00	165.00
Weight of the root	410.00	92.00
Sugar in 100 grams of juice	15.04	11.11
Sugar in the whole root	61.60	10.12

These figures do not need to be discussed. The beetplant in the poor soil certainly received all the mineral food it could need, and yet its weight is not one fourth of that of the plant growing in the normal soil. Something was wanting, and we must inevitably conclude that the substance lacking in B and present in A was humus.

In 1891 another experiment was instituted at Grignon to show how humus acts as a food for certain plants and is quite useless for others. If humic matter is a necessary food for a plant the yield ought to be increased by its presence in the soil. This is the general mode of testing whether a substance is useful or needful to plants. There is, however, an indirect method of acquiring the knowledge we seek. We know that herbaceous plants evaporate very large quantities of water. From the researches of Lawes and Gilbert, Haberlandt, and Hellriegel it appears that for one part of dry matter elaborated from 250 to 300 parts of water are evaporated by the plant. Lawes and Gilbert and Hellriegel have also shown that the proportion of water evaporated increases very rapidly if the plant is growing in a medium poor in plant food. To illustrate, we give the initial and final figures of an experiment by Hellriegel. Barley was grown in pots containing 4 kg. of sand, to which was added calcium nitrate in different proportions. The dry matter of a crop of barley in a pot receiving 1.5 grams of nitrate weighed 25.504 grams. It had evaporated 7,451 grams of water. The weight of water evaporated per gram of dry matter elaborated was $\frac{7451}{25.5}=292$ grams. On a pot without nitrate the crop weighed 1.1 grams. It had evaporated 95 ; grams of water, or 867 grams for 1 gram of dry matter elaborated.

Knowing the amount of water evaporated by a plant we can tell whether the manures applied accord with the nature of the plant. This

mode of investigation was employed to show that grasses do not feed in the same way as legumes.

The *Graminea* experimented with was Italian rye grass (*Lolium italicum*). The *Leguminosa* chosen was ordinary red clover. Each series of experiments comprised five pots containing:

(1) A soil constantly manured from 1875 to 1889, but unmanured since 1889. In the pot it received no manure.

(2) A soil unmanured since 1875, and having therefore lost much humus. It received no manure.

(3) The same as 2, but with chemical manure—sodium nitrate, ammonium sulphate, superphosphate of lime, and potassium chloride—sufficient for a good crop.

(4) The same exhausted soil, to which was added some of the dark-brown liquid which drains from manure heaps. The composition of the liquid manure (including the percentage of nitrogen, phosphoric acid, and potash) was known. In 1891, in order that pot 4 might have the same amount of these substances as pots 3 and 5, chemical manures were added to supply the deficiences.

(5) The same exhausted soil, with liquid manure in 1890 and 1891, and also chemical manure in 1891.

We see, then, that 3, 4, and 5 of each series received the same amount of plant food—nitrogen, phosphoric acid, and potash—but 4 and 5 had humic matter in addition.

These soils were in large pots similar to those already described.

We assume that the water evaporated by each crop is represented by the difference between the rainfall and the drainage water. This is a sufficiently close approximation, for, as the surface of the pot is completely sheltered by the crop, the soil loses by evaporation so little water that it can be neglected.

The following table gives the results of the experiments on rye grass.

Pot experiments on the evaporation by rye grass when differently manured.

No. of experiment.	Soils experimented on.	Manure applied.	Rainfall from April 7 to Sept. 4.	Drainage water from each pot.	Water evaporated by the crop.	Weight of the dry crop.	Water evaporated by each crop for one gram of dry matter.
			Grams.	*Grams.*	*Grams.*	*Grams.*	*Grams.*
31	Soil regularly manured.	None	37,770	9,400	28,370	45	630
32	Exhausted soil	do	37,770	11,140	26,630	39	682
33	do	Chemical manures	37,770	10,650	27,110	102	233
34	do	Liquid manure in 1890, chemical manure in 1891.	37,770	9,900	27,870	64	435
35	do	Liquid manure in 1890 and 1891, chemical manures in 1891.	37,770	8,580	29,190	65	449

The rye grass thrived well and was cut twice. The yield per hectare varied between 2,340 and 6,120 kg. These are average crops. We notice that all the pots evaporated about the same amount of water.

This is singular, for great differences are found between the weights of the different crops.

The chemical manures had a very marked effect, for when they were applied, the crop weighed 102 grams, while it weighed only 39 grams when no fertilizer was present. The liquid manure seems to have been useless.

Column 4 gives the rainfall for each pot 37,770 grams for five months.

Column 5 shows the drainage for each pot. In experiment 32, where the crop weighs the least the drainage is greatest. This is quite natural, for the sickly plants of this pot were not developed enough to evaporate much water. But it is noteworthy that the good crop of 33 evaporated less than the poor crops of 31, 34, and 35, where the drainage was less than for 33.

Column 8 shows the amount of water evaporated per gram of dry matter. The figures differ greatly, but the results agree closely with those of Hellriegel. The strongest plant—that which found the food it preferred—evaporated the least water. The plants on 33, with chemical manures, evaporated only 233 grams of water per gram of dry matter, while the plants of 34 and 35, with liquid from the manure heap, evaporated respectively 435 and 449 grams. The crop of 32, exhausted soil, required 682 grams of water per gram of dry matter.

The crop of the good soil, No. 31, evaporated 630 grams. It is not entirely accurate to say that this soil has been regularly manured, for no manure has been applied since 1889, when it was taken from the field, and it begins to be exhausted.

A series of experiments with clover were conducted in exactly the same way as those on rye grass. The soils were the same and received the same manures.

The clover was cut twice, and furnished average yields—between 3,900 and 5,940 kg. of hay per hectare.

The results of these experiments are recorded in the following table:

Pot experiments on the evaporation by clover when differently manured.

No. of experiment.	Soils experimented on.	Manure applied.	Rain fall from Apr. 7, to Sept. 4.	Drainage water from each pot.	Water evaporated by the crop.	Weight of the dry crop.	Water evaporated by each crop for 1 gram of dry matter.
			Grams.	*Grams.*	*Grams.*	*Grams.*	*Grams.*
36	Soil regularly manured.	None	37,770	9,068	28,702	89	322
37	Exhausted soil	do	37,770	8,140	29,630	65	454
38	do	Chemical manures	37,770	9,050	28,720	72	398
39	do	Liquid manure in 1890; chemical manures in 1891.	37,770	12,410	25,360	99	255
40	do	Liquid manure in 1890 and 1891; chemical manures in 1891.	37,770	11,920	25,850	95	272

While the soils with humic matter bear by far the best plants, the crops with chemical manures are not much better than those on the soil unmanured since 1875.

In column 5 we find that the drainage was greatest for soils 39 and 40, and least for soil 37, which bore the worst crop. Consequently the crop on this soil evaporated the most water.

In column 8 we have the amounts of water evaporated per gram of dry matter. In the exhausted soil 37, the plants wasted much water—454 grams. When the clover found the food it preferred (humic matter), as in 39 and 40, it evaporated 255 or 277 grams, instead of 398 grams, as in case of 38, where no humus had been added.

Summary, conclusions, and practical applications.—From the two experiments we conclude that *Gramineæ* do not need humic matter, and that sodium nitrate is the best nitrogenous manure for these plants. On the other hand legumes—clovers at least—require humic matter, and it is probably to the disappearance of humus in a constantly unmanured soil that we must assign the failures observed when we attempt to grow clover continuously on the same soil.

At first sight it would appear that plants should evaporate at a rate proportionate to the surface of their leaves. Let us see if this is so. In Hellriegel's experiments the plants receiving 1.48 grams of calcium nitrate weighed 25 grams, while those without any nitrate weighed 1.1 gram. The ratio of the two crops is $\frac{25}{1.1} = 22.9$. The ratio between the corresponding amounts of water evaporated is $\frac{7451}{804} = 9.2$. These ratios are far from being equal.

From the Grignon experiments we have seen that the good crop of rye grass on 33 evaporated less than the smaller crops on 31, 34 and 35. The clover on 39 and 40 evaporated less than the other crops which were not so good. Evaporation does not, therefore, depend entirely on the surface area of the leaves; it depends also on the amount of water which the roots furnish to the plant and to the leaves.

It is easy to see that plants develop more roots when their food is scarce. They adapt themselves to the wants of the plant. When a plant is growing in a soil poor in plant food it seeks its nourishment everywhere, and sends roots in every direction to find the food it needs. But if the medium in which the plant is growing is very rich the roots find in a very small space all that is wanted by the plant, and therefore have no reason for extending.

The following experiments show this plainly: Small pots containing gravel were sown with cress; one received no manure, the other received complete chemical manure. When the plants were well developed the stems and leaves were carefully collected, dried, and weighed; the same was done for the roots after being washed. The same experiment was repeated on rye grass. The following results were obtained:

Relation between roots and stems and leaves of plants grown in manured and unmanured soils.

	With manure.	Without manure.
CRESS.	*Grams.*	*Grams.*
Stems and leaves	2.83	0.83
Roots	0.37	0.18
Total weight	3.20	1.01
Weight of the roots, that of the stems being 100	12.80	21.60
RYE GRASS.		
Stems and leaves	2.79	1.22
Roots	0.85	0.96
Total weight	3.64	2.18
Weight of the roots, that of the stems being 100	30.40	78.60

The same differences can be observed by growing cress in distilled water and in ordinary water. The results confirm what we have said above. In this way we can explain why a sickly plant evaporates proportionally more water than a healthy plant. It is probably because having small stems but many roots it is plentifully furnished with water, and wastes more than a plant with strong stems but short roots.

The preceding experiments show that herbaceous plants, like cereals, evaporate from 250 to 300 kg. of water per kg. of dry matter elaborated, when the plants find in the soil all the food they need. The amount of water evaporated is twice as large when the soil is poor. For this reason manures are necessary for dry soils.

In the north of Europe and in Algeria many farmers never apply any manure. Generally the crops are below the average. Great advantage would probably result from moderate applications of inexpensive mineral fertilizers. The crops would evaporate less of the water which is so scarce in those climates.

At Grignon also crops often suffer from drought. This is due largely to the great permeability of the subsoil which is of white chalk. The yields of wheat were poor in the seasons of 1889 and 1890, which were hot and dry, but on the whole good for the average soils of France—better than in the season 1888, which was rainy. In this year the average yield in France was rather low, while at Grignon the yield of grain per hectare reached 60 hectoliters—a considerable amount. At Grignon, however, good results are obtained only when the soil regularly receives fertilizers, especially farmyard manures.

THE PHOSPHORIC ACID OF THE SOIL.

We have seen that a soil cultivated without manure soon becomes incapable of bearing good crops of clover, wheat, and corn, but can still bear a fair crop of oats. We have shown that this decrease in the fertility of the soil may be partly assigned to the loss of humus, involving a loss of nitrogen. But the soil may also have lost some mineral substance which may be a necessary food for the plants.

During the first years of the experiments at Grignon, superphosphates were tried several times, but they never gave good results. Analysis showed that the soil contained 1.7 grams of phosphoric acid per kilo in 1880, and it was concluded that this amount was more than sufficient for the needs of the plants. Assuming that the soil of one hectare to the depth of 35 centimeters weighs 4,000 tons, we have a total amount of 6,800 kg. of phosphoric acid per hectare. As an average crop removes about 40 kg. of phosphoric acid per hectare, and as the drainage waters wash out only insignificant amounts of this substance, it was thought that a long period might elapse before the soil would need an application of superphosphates; nevertheless in 1889 superphosphates were applied on one half of a plat in clover, unmanured since 1857. No improvement was found.

The following year, 1890, this same plat bore wheat, and here we found remarkable results. While the weight of the grain was 800 kg. per hectare for the constantly unmanured plat, it reached 2,200 kg. on the soil receiving superphosphates, and 2,400 kg. when potassium chloride was applied with the superphosphates.

More than 1 gram of phosphoric acid per kg. being found in the soil, we must inevitably conclude that it was in a state unassimilable by plants, or at any rate by wheat. We conclude also that the ordinary mode of determination of the total phosphoric acid of the soil (digestion with nitric acid) gives no data as to the possible necessity of applying superphosphates on the land.

When plants assimilate phosphoric acid, this substance is dissolved either by the water of the soil in the presence of certain substances—carbonic acid, etc.—or by liquids excreted by the roots of the plants themselves. In any case these solvents are far from having the properties of the nitric acid with which the soil is digested in analysis. In 1879 acetic acid was tried at Grignon, as a solvent which resembles the solvents of the soil or of the plants. As a general rule acetic acid dissolves the phosphates of protoxides (lime and magnesia) but is without any action on the phosphates of sesquioxides (iron and alumina). In that year it was found that the Grignon soil contained more than 0.3 grams of phosphoric acid, soluble in acetic acid. In 1890 the exhausted soil was found to contain only traces of phosphoric acid soluble in weak acids. Calculating the loss to kg. per hectare, we find the soil must have lost 1,200 kg. of assimilable phosphoric acid during a period of ten years. What became of it?

(1) It may have been removed by the crops. This hypothesis is untenable, for an average crop removes at most 40 kg. of $P_2 O_5$ per hectare; for ten years the loss by removal would be less than 400 kg., only a third of that which has really disappeared.

(2) The phosphoric acid, formerly assimilable and soluble in weak acids, may have become unassimilable and insoluble. This is quite possible. It has repeatedly been observed that phosphate of lime, mixed with

some earth, and in the presence of carbonic acid, is acted upon by the iron and alumina compounds of the soil, and converted into insoluble phosphate (Thénard).

(3) Some of the phosphoric acid may have been washed away by the drainage waters. Generally the drainage waters are exceedingly poor in phosphoric acid, and it is not probable that this is the predominating cause.

We assume, therefore, that in the soil of the constantly unmanured plats the phosphoric acid has now become totally insoluble in weak acids, and unassimilable. How is it that for the regularly manured plats no change has taken place in the phosphoric acid? It seems that the addition of barnyard manure has prevented the soluble phosphates from reverting. How this comes about we can not explain fully; further investigations are necessary to throw light on the subject.

In 1891 superphosphates were tried on a plat bearing oats, and constantly unmanured since 1875. The yields of grain per hectare in this case with that on a part of the same plat without superphosphate, and with that on the constantly manured plats were as follows:

		Kg.
Constantly manured plats		3,600
Constantly unmanured plat	Superphosphates in 1891	3,000
	Without superphosphate	2,800

Thus oats seem to thrive nearly as well in what we have called an exhausted soil as in a constantly manured soil. The preceding years but little difference was evidenced between the yields on manured and unmanured plats. We may say that oats easily find the food they need; for this plant the phosphoric acid is still assimilable, while it has become unassimilable for wheat, clover, and beets.

The importance of this subject is obvious. We can not say that a particular element of the soil is assimilable by plants in general, but we must consider each plant in particular. It is difficult to explain these differences. We do not think that oats have more roots than wheat and thus have more action on the substances in the soil. We rather think that the roots of oats produce a larger amount of acids, or perhaps more powerful acids, than the roots of wheat; in this way the former plant would obtain the food it needed where others would sicken.

Conclusions.—(1) Grignon soil in good condition, receiving barnyard manure every year or so, does not yield better crops when manured with superphosphates; these are useless at Grignon.

(2) This soil contains a fair proportion of phosphoric acid soluble in acetic acid, therefore supposed to be in a state easily assimilable by plants.

(3) When the soil is constantly unmanured the phosphoric acid reverts and becomes entirely insoluble in weak acids, the total amount of this substance having very slightly diminished.

(4) At the same time the soil bears extremely small crops of certain plants—wheat, clover, and beets. This sterility is in a great measure

due to the absence of assimilable phosphoric acid, for by applying superphosphates the yields are considerably improved.

(5) This same soil, however, which is incapable of bearing a good crop of wheat, can still bear average crops of oats. For this plant the phosphoric acid is still assimilable. Different plants have different needs.

We hope soon to give the results of further investigations on the reversion of the phosphoric acids of the soil.

ABSTRACTS OF PUBLICATIONS OF THE AGRICULTURAL EXPERIMENT STATIONS IN THE UNITED STATES.

CHEMISTRY.

E. W. ALLEN, *Editor.*

A study of the losses of nitrogen in the air-drying of fermentable substances, W. FREAR and G. L. HOLTER (*Pennsylvania Sta. Report for 1891, pp. 123–133*).—The authors review quite fully the literature of this subject, showing that considerable losses have been observed in air-drying certain materials previous to sampling for analysis, notably in the cases of silage and barnyard manure. They planned and carried out a series of experiments to study these losses more thoroughly, and especially to study the König method of determining the nitrogen in the original material without previous air drying. This method consists in digesting 100 to 200 grams of finely chopped, fresh substance in a porcelain dish with 100 to 150 c. c. of sulphuric acid such as is used in the Kjeldahl digestions, until a pasty, homogeneous mass is obtained. This is cooled, and 30 to 60 grams taken for analysis by the Kjeldahl method.

The materials used by the authors were corn silage, the fresh dung of sheep, and the fresh dung of steers fed exclusively on hay. The nitrogen was determined in each case, (1) by the König method in the fresh material, (2) by the König method after keeping the material in a closed jar for some days with a few drops of carbon disulphide; (3) by the Kjeldahl method after air-drying the material at 60° to 70° C.; and (4) by the Kjeldahl method after air drying the material previously sprinkled with dilute hydrochloric acid, a number of parallel tests being made in each instance.

The results of these studies are tabulated. They indicate no loss of nitrogen in air drying corn silage and steer dung, but a loss of about 12 per cent of the nitrogen in sheep dung, which was only slightly diminished by sprinkling the material with hydrochloric acid before drying.

The failure of the hydrochloric acid to prevent the escape of the major portion of that nitrogen which was volatilized may be due to incomplete moistening with the

acid or to the non-basic character of the volatile material in which it escaped. An effort was made to collect the volatile matter for examination and direct quantitative determination, but owing to failure of the apparatus this was prevented. It is evident, however, that there is serious danger of loss in the air-drying of even fresh dung containing one-half per cent of nitrogen in the fresh material, and that preliminary moistening with hydrochloric acid affords no certain prevention of such loss.

The average loss observed in this case is sufficient to elevate a coefficient of digestibility of 44 to an apparent coefficient of 50, a difference altogether too important to be disregarded.

In general, therefore, while the results, like those of earlier investigators in the same line, show different materials to behave very differently as regards the loss of nitrogen in air-drying, they do show the importance of a very thorough study of various fresh substances upon this point.

The König method was found less convenient and more tedious than air-drying the material, and the parallel results where it was used did not agree as closely as where the sample was air-dried. The method is believed to be applicable in some cases, and it is suggested that collective or composite samples may be made in this way for analysis. "The results in the cases where the fresh material was inclosed in jars to which a few drops of carbon bisulphide had been added show no evidence of loss of nitrogen."

METEOROLOGY.

W. H. BEAL, *Editor.*

Rainfall at Iowa Station, E. N. EATON and E. S. KING (*Iowa Sta. Bul. No. 20, Feb., 1893, p. 732*).—The total precipitation (rain and melted snow) for the year ending February 28, 1893, was 33.93 inches.

Meteorological observations at the Maine Station, M. C. FERNALD (*Maine Sta. Report for 1892, pp. 147–170*).—Observations with hygrometers, soil thermometers, and terrestrial and solar radiation thermometers, and on the amount of sunshine, velocity of the wind, and rainfall are summarized for each month from April to October, 1889 to 1892, inclusive, together with a detailed daily record of the observations for October, 1892.

Observations with hygrometers.—"It appears from observations covering the period of growth of four years that the excess of moisture in forest above that of open field in the morning amounts to but 6 per cent, while in the middle of the day it rises to 14 per cent, and at nightfall drops down to 10 per cent, and that the mean excess for the day is 10 per cent. In a very dense forest the percentage of excess would undoubtedly rise much higher. The presence of patches of forest in any region exerts a marked influence on the hygroscopic conditions of the atmosphere, and this condition, in turn, is an important factor in the growth of vegetation."

The average excess of solar intensity above that given by the maximum thermometer for the growing periods of 1889, 1890, 1891, and 1892 was 57.12° F. During the seasons (April-October) of 1890, 1891,

and 1892 the average number of hours of bright sunshine per day was 6.4, or 46 per cent of the possible amount. The average velocity of the wind in 1890 was 8.9 miles per hour; in 1891, 8.95 miles; and in 1892, 9.5 miles. The total rainfall in 1889 was 18.85 inches; in 1890, 32.52 inches; in 1891, 23.07 inches; and in 1892, 21.62 inches. The rainfall in May, 1892, amounting to 10.13 inches, was larger than in any other month in twenty-four years.

Meteorological summary for Massachusetts State Station (*Massachusetts State Sta. Bul. No. 47, May, 1893, p. 1*).—A summary for the months of January, February, March, and April, 1893, with summaries for the corresponding months in 1892 for comparison.

Weather summary for New Hampshire, November, 1891-October, 1892 (*New Hampshire Sta. Report for 1890 and 1891, pp. 264-281*).—Weather observations for each month, by the New England Weather Service at sixteen stations in the State, are tabulated and discussed.

The following table gives a summary of the observations at thirteen of these stations:

Summary of meteorological observations for the year.

Stations.	Temperature.				Precipitation.		Rainy days.	
	Mean.	Highest.	Lowest.	Absolute range.	Total rain and snow.	Un-melted snow.	Total.	Monthly average.
	Deg. F.	*Deg. F.*	*Deg. F.*	*Deg. F.*	*Inches.*	*Inches.*		
Berlin Mills	41.4	94	−24	118	41.84	73	136	11
Concord	46.7	93	− 8	101	38.29	46	108	9
Hanover	44.5	89	−11	100	37.12	28	111	9
Littleton	....	89	−16	105	42.99	59	119	10
Manchester (a)	49.2	98	−16	114	35.68	43	118	10
Manchester (b)	47.5	95	− 2	97	34.28	55	125	10
Nashua	49.7	96	− 7	103	35.87	54	101	8
Newton	47.0	94	− 2	96	.....	38	89	7
North Conway	44.0	98	−13	111	40.82	53	83	7
Plymouth	43.7	98	−12	110	46.16	45	118	10
Stratford	45.0	98	−20	118	41.34	54	109	9
Walpole	44.7	94	−22	116	37.19	48	102	8
West Milan	41.1	94	−28	122	45.13	60	132	11
Average	45.3	94	−13	108	39.72	50	111	9

The code of signals for flashing weather forecasts from Mount Washington with the electric search light is explained.

Meteorology, W. FREAR (*Pennsylvania Sta. Report for 1891, pp. 189-193, 202-208, 217-246*).—The work in 1891 was along the same lines as that reported in the Annual Report of the station for 1890 (E. S. R., vol. III, p. 720) and included general observations on atmospheric phenomena, sunshine records, and soil temperatures. Monthly summaries of meteorological observations and weekly crop reports are given in the body of the report, and the detailed record of daily observations in an appendix. The summary of observations for the year is as follows:

Summary of meteorological observations.

	Year 1891.	Winter (Oct., 1890, to Mar., 1891).	Growing season (Apr. to Sept., 1891).
Barometer (inches):			
Mean	38. 038		
Highest	30. 765 (Nov. 19)		
Lowest	29. 159 (Nov. 23)		
Temperature (degrees F.):			
Mean	48. 17	34. 96	62. 08
Highest	92 (Aug. 11)		92 (Aug. 11)
Lowest	0. 0 (Mar. 2)	0. 0 (Mar. 2)	20 (Apr. 5)
Annual range	92		
Mean daily range	18. 35		20. 7
Greatest daily range	40 (Nov. 17)		35 (June 28)
Least daily range	2 (Feb. 8, and Mar. 8)		
Mean daily relative humidity (per cent)	76. 17		71. 6
Rainfall (inches):			
Total	45. 82	23. 36	20. 91
Greatest monthly	5. 65 (July)		
Greatest daily	1. 52 (Oct. 7)		1. 39 (July 30)
Number of days on which 0.01 inch or more of rain fell	140		69
Mean percentage of cloudiness	58. 74		49. 98
Number of days on which cloudiness averaged 80 per cent or more	131	102	48
Average hours of sunshine per day			6 h., 41 m.
Wind (miles):			
Total movement	31, 574		
Maximum velocity	, 034 (Apr. 22)		
Greatest daily movement	, 415 (Dec.)		
Last frost in spring			May 4.
First frost in fall			Sept. 30.

Principal periods of crop development.

Wheat:
- Sown September 5, 1890.
- Ripening June 22, 1891.
- Cut July 8–9.

Corn:
- Planted May 9.
- Tasseling July 22–27.
- In milk August 29.
- Cut September 22.
- Husked Ocotber 21.

Oats:
- Sown April 18.
- Heading June 22.
- Cut July 27–31.

Grass.
- Haying begun June 25.
- Haying ended July 16.

The winter of 1890–'91 was much like the preceding, being a little colder on the average, but not reaching the minimum attained in that of 1889–'90; the degree of cloudiness and of total precipitation were similar, but this year three times as many inches of snow fell as in the winter preceding, securing a covering for a much greater length of time. As in that year, frosts occurred in early May and late in September; but this year the fruit in this locality was injured to only a trifling degree.

The humidity, rainfall, and number of rainy days were considerably less, and there was, on the average, half an hour more sunshine daily during the growing season. But in the early spring the growth of wheat and grass was much retarded by cold rains, which were followed by protracted drought that injured the hay and threatened to destroy the oats and barley. Hay harvest was much interfered with, owing to rains; oat harvest was similarly retarded, and fall plowing. The potatoes, especially the earlier varieties, were caused to rot by the excessive moisture. The fall was severer than for many years, and, while it promoted the curing of corn and harvesting of late potatoes and roots, it severely injured the young wheat.

Meteorological report, J. DRYDEN (*Utah Sta. Report for 1892, pp. 204–214*).—A summary of temperature readings for each month of 1892 at ten stations in different parts of the State furnished by the Utah Weather Bureau, and tabulated daily and monthly summaries of observations at the station during 1891 and 1892 on temperature, pressure, humidity, dew-point, and precipitation. The following is a summary for ten months (March–December) of each year: *Pressure* (inches).—Average 1892, 24.949. *Air temperature* (degrees F.).—Highest 1891, 79.75; 1892, 80.33; lowest 1891, 25.50; 1892, 22.85; mean 1891, 52.15; 1892, 51.27. *Precipitation.*—Total rainfall (inches) 1891, 6.16; 1892, 8.16.

The station at Logan is 4,777 feet above the sea level. The average barometric pressure for ten months of 1892, as will be observed, was 24.95 inches. It is explained that the figures for relative humidity, which range for the months of April–September, 1892, from 51.22 to 76.8, and for dew-point, which range for the same months from 28.35 to 66.36, are probably too high, due to evaporation from excavations in progress near the thermometer cage.

WATER—SOILS.

W. H. BEAL, *Editor.*

Value of natural waters to crop growth, W. P. CUTTER (*Utah Sta. Bul. No. 22, May, 1893, pp. 8–12*).—"The chemical department of the station has undertaken a study of the water supply of the Territory in order to ascertain, as far as possible, the amount of food furnished to crops by natural or artificial irrigation."

Some general remarks are made on composition of water, the annual rainfall of Utah, irrigation waters, and analyses of samples taken from the Logan, Bear, Weber, Ogden, Jordan, and Provo rivers. In the case of each river water, samples were taken every week during the irrigation season, these were united, and an average sample analyzed. The results of the analyses are given below:

Analyses of the waters of Utah rivers.

[Parts per million.]

Name of river.	Total solids.	Lime.	Magnesia.	Potash.	Chlorine.	Nitrogen.
Logan	175.2	66.10	18.00	1.31	3.4	0.07
Bear	290.4	80.02	15.74	3.69	3.7	0.11
Provo	224.5	67.97	13.41	4.42	0.8	0.11
Weber	302.0	76.09	12.74	7.04	3.3	0.16
Jordan	401.0	76.20	27.70	3.20	19.0	0.11
Ogden	275.6	72.10	18.30	3.73	4.2	0.10
Average	278.1	73.08	17.65	3.89	5.7	0.11

"Considering the weight of water in a layer 1 inch deep to be 225,000 pounds per acre, we can calculate from the above table the amount of the different compounds brought on the soil with each inch of irrigation water. The average amount in pounds per acre is as follows: Total solids 62.57, lime 16.44, magnesia 3.97, potash 0.87, cholorine 1.28, nitrogen 0.025.

"In no one of the river waters was phosphoric acid present."

An analysis is also given of water from an artesian well on the shore of Great Salt Lake. The water was found to be "a strong solution of common salt and chlorides of lime, magnesia, and potash."

Soil temperatures and terrestrial radiation, M. C. FERNALD (*Maine Sta. Report for 1892, pp. 152–161*).—"The periods covered by the experiment are from May 1 to November 1, 1889, and from April 1 to November 1, 1890, 1891, and 1892, with thermometers placed in the soil [in an open field] to the depths of 1, 3, 6, 9, 12, 24, and 36 inches. * * * The mean daily range at the depth of 1 inch during the period of observations was 5.22°; at a depth of 3 inches, 4.54°; at the depth of 6 inches, 1.81°; at the depth of 9 inches, 1.02°; and at 12 inches very slight. * * *

" Comparing soil temperatures with air temperatures during the four seasons, the following mean results appear: At the depth of 1 inch the temperature of the soil was lower than that of the air by 2.32°; at the depth of 3 inches, by 2.12°; 6 inches, by 3.22°; 9 inches, by 3.94°; 12 inches, by 4.12°; 24 inches, by 5.86°; and at the depth of 36 inches, by 7.16°."

The mean terrestrial radiation for the four years was 7.31° and the greatest range 19.5°.

Soil temperatures, W. FREAR (*Pennsylvania Sta. Report for 1891, pp. 194–201, 247–270*).—Tabulated daily and monthly summaries of tri-daily observations during 1891 with thermometers at the surface of the soil and at depths of 1 to 24 inches. The following is a yearly summary of the soil temperatures for the growing season, April to September, 1891:

Soil temperatures, April to September, 1891.

Depth.	Highest.	Lowest.	Daily mean.	Mean daily range.	Greatest daily range.
	Degrees F.	*Degrees F.*	*Deg. F.*	*Degs.*	*Degrees.*
At surface	84 (June 16)	31 (Apr. 5)	62.08	10.35	25 (Apr. 30 and May 19).
1 inch deep	82 (June 15 and 16)	29 (Apr. 8)	61.38	9.09	20 (May 10 and 19).
3 inches deep	79 (June 16)	31.5 (Apr. 6)	61.50	6.44	16.5 (Apr. 30).
6 inches deep	75 (June 15)	33 (Apr. 5)	61.50	3.34	8.5 (Apr. 30 and May 8 and 19).
12 inches deep	72.5 (Aug. 10, 11, and 12)	35 (Apr. 6, 7, and 8)	61.50	1.67	6.5 (June 4).
24 inches deep	69 (Aug. 12)	36.5 (Apr. —4 days)	61.00	0.31	2.0 (May 23).

FERTILIZERS.

W. H. BEAL, *Editor.*

The use and value of manure, J. W. SANBORN (*Utah Sta. Report for 1892, pp. 77–90*).

Synopsis.—The desirability of preserving and using farm manure is explained. In experiments on wheat and barley the increase due to the manure was about sufficient to pay the cost of application. Plowing under gave better results than harrowing in or applying on the surface. Unfermented manure gave a higher yield than fermented. There was little difference in effect between manures from different animals. Solid manure alone proved inferior to the mixed solid and liquid excrement, and housed manure was superior to unhoused.

General information, observations, and reports on experiments at the station are given under the following head: Manured *vs.* unmanured soil; methods of application of manure; fermentation of manure; relative value of cattle, horse, sheep, and hog manure; solid and liquid manure; and housed *vs.* unhoused manure.

Manured vs. unmanured soil (pp. 77–79).—Of two plats seeded to wheat one was manured at the rate of 10 tons per acre and the other remained unmanured. The results during 1891 and 1892 are tabulated.

"The gain from the use of the manure is 62 per cent wheat and 62 per cent straw, or 6.6 bushels of wheat and 660 pounds straw, having a value of $5 at this place. This sum just about pays for the application of manure."

Determinations of moisture in the soil showed a very slight difference in favor of the unmanured plats.

Methods of application of manure (pp.79–84).—Four plats were manured at the rate of 13½ tons per acre, as follows: (1) Applied on top of the ground and harrowed in, (2) plowed under, (3) left wholly on top without being harrowed into the soil, and (4) applied in winter. A check plat remained unmanured. The yields of grain and straw of barley in 1890 and of wheat in 1891 and 1892 are tabulated.

The largest yield of wheat and of wheat and straw was secured on the plat where the manure was plowed under. The next largest yield was where it was applied on top of the ground in the winter and laid on a level soil to be washed into the ground, for here, unlike lands in the East, very little, if any, water runs off the surface of our level grounds. It will also be seen that when the manure was harrowed in it gave better results than when it lay wholly on top, both being applied at the same time in the spring. * * *

A fact prominently brought out is that the ratio of straw to grain varied very much with the different methods of application. When harrowed in there were 77 pounds of straw per bushel of wheat. When plowed under there were 94 pounds of straw to each bushel of wheat; when unmanured, 64 pounds of straw to a bushel of wheat; when manured in winter on the surface, 94 pounds of straw to a bushel of wheat.

The moisture content of the unmanured plat was again found to be slightly greater than that of the manured plat.

Fermentation of manure (pp. 84, 85).—One plat 2 by 6 rods was treated with fermented manure, and one of the same size with unfermented manure from the same source.

The fermented manure was rather imperfectly fermented, our short springs not giving time or warmth enough to secure the fermentation desired. The process of preparing the manure was that of piling it up in a compact body so that it would not ferment, and of placing that to be fermented in heaps as lightly as possible with straw between the layers in order to admit the air. * * * The yield for 1892 was: Fermented manure, 14 bushels of wheat and 2,166 pounds of straw; unfermented manure, 20 bushels of wheat and 2,706 pounds of straw.

Relative value of cattle, horse, sheep, and hog manure (pp. 85–87).—In 1891 and 1892 each of these kinds of manure was applied separately, at the rate of 1 ton per plat, in 1891 and 1892, to plats 2 by 6 rods, seeded to wheat. The tabulated results with the different manures indicate that "the difference in yield is not material and is within the limits of possible error or within that of the natural variation of the soil in fertility."

Solid and liquid manure (pp. 87–89).—On one plat 2 by 6 rods solid manure alone was applied, while on a similar plat a mixture of solid and liquid manure was applied. Wheat was the crop grown. It appears "that a decisive gain of grain was made by using the solid and liquid manure together, amounting to 6.7 bushels or 29.9 per cent."

Housed vs. unhoused manure (pp. 89, 90).—Manure which had been spread out in layers 4 to 6 inches deep on loosely jointed boards in the open air and allowed to weather and that which had been housed was used on parallel plats 2 by 6 rods seeded to wheat in 1891 and 1892. The yields of straw and grain during each year are given in a table.

"A small gain in the yield of grain is noted for the housed manure."

The value of "German moss" as a litter, W. FREAR (*Pennsylvania Sta. Report for 1891, pp. 186–189*).—This material "is being imported in considerable quantity into our seaboard cities for use in bedding horses especially, and sold at a price such that it enters into competition with straw." It is derived from species of *Sphagnum* common in bogs and swamps in this country. Tests at the station showed that 1 pound of the compressed moss absorbed on the average 13.46 pounds of water—an absorptive capacity far surpassing that of the materials commonly employed as litter. Determinations of the fertilizing constituents gave the following results: Nitrogen, 0.65 per cent; potash (practically all soluble), 0.095 per cent; and phosphoric acid, 0.03 per cent.

Fertilizer experiments, G. H. WHITCHER (*New Hampshire Sta. Report for 1890 and 1891, pp. 181–193*).—A reprint of Bulletin No. 12 of the station (E. S. R., vol. II, p. 734).

Coöperative fertilizer experiments, G. H. WHITCHER (*New Hampshire Sta. Report for 1890 and 1891, pp. 156–168*).—A reprint of Bulletin No. 10 of the station (E. S. R., vol. II, p. 412).

FIELD CROPS.

J. F. DUGGAR, *Editor.*

Influence of variety and of rate of seeding on the yield of silage corn, H. P. ARMSBY (*Pennsylvania Sta. Report for 1891, pp 17-26*).—A reprint of Bulletin No. 15 of the station (E. S. R., vol. II, p. 741).

Influence of variety and of rate of seeding on the yield of soiling corn, H. P. ARMSBY (*Pennsylvania Sta. Report for 1891, pp. 26-32*).—Previous experiments at the station (Reports for 1887, 1888, 1889, and 1890) having shown that the yield of dry matter per acre for soiling purposes could be largely increased by planting the larger varieties of corn and allowing them to approach maturity before harvesting, it was considered desirable to test the relative value of flint corn as a soiling crop. The plan of the experiment was similar to that with silage corn referred to above. A flint corn (mixture of common varieties) and a large dent variety (Breck Boston Market Ensilage) were planted side by side, each variety being seeded at two different rates (kernels 7 and 14 inches apart in drills 3½ feet apart). There were some irregularities in planting and manuring, but it is thought that they did not materially affect the general result. The corn was harvested September 20. Tabulated data are given for the chemical composition of the crop and the yield of nutrients per acre. There was no material difference in the composition of the thin-seeded and thick-seeded corn, but the yield of dry matter was 27 per cent greater from the thicker planting.

"The coarse dent variety used gave an average yield of 45 per cent more dry matter per acre than did the flint corn.

"The quality of the flint corn, as indicated by chemical analysis, was considerably better than that of the dent corn, it being less woody and containing more protein. When fed whole (uncut) the flint corn was eaten clean, except in one case, where a small residue was left, while 12½ per cent of the dent corn was left uneaten. When the fodder was cut both varieties were eaten clean, except in a single instance."

Tillage of corn, J. W. SANBORN (*Utah Sta. Report for 1892, pp. 108-120*).—*Mulching and depth of cultivation* (pp. 108-116).—The following methods of treating the corn crop were tested: Scarifying the surface of the ground with garden rake; cultivation with scuffle hoe; shallow, medium, and deep tillage; no tillage, weeds pulled; no tillage, weeds not pulled; mulching with dirt, cut straw, and whole straw. The results are tabulated. "The plats were uneven, and although duplicated for three years are still somewhat uncertain in their bearings." The author considers that the test favors shallow cultivation.

Determinations of moisture and temperature of the soil are also given, but these records are vitiated by the unevenness of the ground.

The weight of corn roots at different depths was determined, and the results showed a large increase in the weight of roots from the first to

the fourth inch in depth. Below the fourth inch the quantity of roots decreased to the eighth inch, in which it was less than in the first inch of soil.

Hilling and check-rowing corn (pp. 116–120).—Experiments bearing on these two methods were made in 1891 and 1892. The results for 1892 are given below. Corn checked, tilled both ways, and not hilled, yielded 39.64 bushels per acre; checked and hilled both ways, 36 bushels; checked, then tilled, and hilled one way, 42.84 and 43.5 bushels; drilled and tilled one way, 43.5. The soil temperatures were taken. "The temperature of the hills of corn was much less than between the rows."

Cost of cotton production and profit per acre, G. W. CURTIS and J. W. CARSON (*Texas Sta. Bul. No. 26, Mar., 1893, pp. 289–310*).

Synopsis.—Statements of the cost and profit of raising cotton in different parts of the State, based on the accounts of farmers; also cost and profit of raising cotton with different fertilizers on the station farm. In every case the cost of production was considerably below the selling price. On the station farm, cotton grown on unfertilized land cost more per pound than that grown on fertilized plats.

In determining the expense of growing cotton, labor was estimated at $1 per day, a man and a single team at $1.62½ per day, and a man and double team at $2.25 per day. The items of expense included rent of land, which varied in different sections of the State from $3.50 to $7.98 per acre; seed, fertilizer when used, expense of preparation, planting, cultivation, picking (at 50 to 65 cents per 100 pounds of seed cotton), marketing, ginning, and also bagging and ties. In one case the salary of manager was also charged at $1.50 per acre, and in another case barnyard manure was used and one half its value charged. The seed was valued at from 10 to nearly 11 cents per bushel, but was sometimes given to pay for ginning.

The following table gives a condensed summary of the figures furnished by farmers:

Cotton—yield, cost of production, and profit, reported by farmers in Texas.

Statement number.	Yield of lint per acre.	Selling price per pound of lint.	Expense per pound of lint.	Expense per acre.	Profit per acre.
	Pounds.	*Cents.*	*Cents.*		
1	650	9.0	4.09	$30.55	$31.95
2	418	8.5	4.62	22.32	16.18
3	250	8.5	5.47	*13.68	7.57
4	250	7.0	5.24	14.71	4.39
5	426	7.5	5.00	*21.31	10.64
6	500	7.0	†2.12	†13.85	24.40
7	250	8.5	5.66	14.15	7.10

* Expense of ginning, bagging, and ties paid by cotton seed, and not included in these figures.
† Harvested with Cunningham cotton harvester at an estimated expense of 10 cents per 100 pounds of seed cotton.

The following table gives the figures obtained in growing cotton with different fertilizers on the station farm:

Financial results from using different fertilizers on cotton.

Statement No.	Fertilizers.	Yield of lint per acre.	Selling price per pound of lint.	Expense per pound of lint.	Expense per acre.	Profit per acre.
		Pounds.	*Cents.*	*Cents.*		
9	300 pounds cotton-seed meal 300 pounds superphosphate 50 pounds kainit	544	9.625	5.77	$34.90	$20.96
10	125 pounds cotton-seed meal 125 pounds superphosphate 50 pounds cotton-hull ashes	484	9.625	5.42	29.36	20.34
11	150 pounds bone meal 150 pounds cotton-hull ashes	423	9.625	5.78	27.17	16.25
12	5 tons barnyard manure	502	9.625	5.57	31.23	20.30
13	No fertilizer	283	9.625	6.02	18.84	9.21

Varieties of grasses, forage plants, and corn, J. W. SANBORN (*Utah Sta. Report for 1892, pp. 67–76, 190–203*).—Twenty-five irrigated plats on "upper bench land" were used in experiments with leguminous forage plants and varieties of grasses.

The following table gives the yearly and average yields of hay of certain plats for 1891 and 1892, also the water content and total dry matter of the crop of 1892:

Yield of hay from different forage plants.

	1891.	1892.	1892.	1892.	1891–1892.
	Yield per acre.	Yield per acre.	Water content.	Dry matter.	Average yield.
	Pounds.	*Pounds.*	*Per cent.*	*Pounds.*	*Pounds.*
Mammoth clover	2,680	3,200	39.95	1,920	2,940
Alfalfa	2,860	4,700	19.22	3,790	3,780
Alsike clover	3,560	2,000	18.49	1,630	2,780
Sainfoin or esparcet	2,501	1,500	10.53	1,342	2,000
Meadow fescue	2,800	1,600	12.72	1,397	2,200
Tall fescue	2,691	1,350	13.66	1,166	2,020
English rye graas	1,260	1,560	14.59	1,333	1,410
Italian rye grass	820	800	21.39	629	810
Bokhara clover (*Melilotus alba*)	7,700	....	....	....	....
Redtop	2,500	1,600	....	....	2,050
Timothy	2,340	1,800	17.67	1,482	2,070

In 1892 rough-stalked meadow grass yielded 1,100 pounds of hay per acre, containing 18.6 per cent water; tall meadow oat grass 1,800 pounds, with 13 per cent water; sheep's fescue 2,200 pounds, with 13.7 per cent water; red clover 2,500 pounds, with 18.2 per cent water. Thin stands and other conditions vitiated the figures for the remaining plats.

"Bokhara clover (*Melilotus alba*) gave a great yield, and is better adapted to our climatic condition than any crop tried, yet what to do with it is not clear." This crop was not harvested till 55 inches high.

Meadow foxtail grass and sainfoin were the earliest kinds tested.

Forage crops (pp. 190–192).—Notes on the growth of white lupines, pearl millet, German millet, Golden Wonder millet, common millet,

Rural Branching sorghum, white durra, spring vetch, teosinte, varieties of saccharine sorghum, Kaffir corn, yellow millo maize, Jerusalem corn, *Lathyrus sylvestris*, and rape. The following varieties of non-saccharine sorghum succeeded: Edna, Jagari, Jhus, Bansmati, Lebar, and Badala.

Corn (pp. 193–203).—The dates of planting, tasseling, silking, and harvesting are given; also the yields of fodder and the corrected yields of corn. The experiment was in progress for three years.

"In 1890, 6 flint varieties, 5 semi-dent varieties, and 7 dent varieties were grown, and all matured. In 1891, 8 flint varieties were grown, one of which did not mature; 6 semi-dents were grown, two of which did not mature; 7 dents were grown, 5 of which did not mature. In 1892, 8 flints, 4 semi-dents, and 11 dents were grown, all maturing."

Experiments with oats, barley, and corn, T. F. HUNT (*Pennsylvania Sta. Report for 1891, pp. 44–61*).

Synopsis.—The subjects and results of the experiments included in this report were as follows: (1) Oats, rate of seeding—the yield of grain varied very little from seeding between 8 and 18 pecks per acre; (2) oats and barley, soil preparation—plowing, and harrowing or rolling to an ordinary extent was as good as any other method; (3) oats, time of seeding—any time in April was satisfactory; (4) corn, depth of seed bed—plowing 6 inches deep gave the best results; (5) corn, depth and frequency of cultivation—ordinary cultivation to depths of 2 and 4 inches was most satisfactory; (6) corn, rate of planting and distribution of seed—one kernel every 6 inches for grain and every 3 inches for stover, in rows 42 inches apart, gave the largest yields, the number of kernels in a hill being immaterial; (7) corn, topping—the yield of grain was decreased; (8) corn, detasseling—the yield was not affected by removing the tassels on alternate rows.

The experiments reported in this article were on a rather compact limestone clay soil. There was a marked deficiency of rainfall during April and May and an excess in August.

Oats, rate of seeding (pp. 45–47).—Notes and tabulated data for an experiment with Japan oats on 28 twentieth-acre plats, seeded at the rate of from 5 to 18 pecks per acre. Fourteen of the plats were manured with well-rotted barnyard manure at the rate of 10 tons per acre and the others were unmanured. The yields of grain varied very little from seeding between 8 and 18 pecks per acre. When only 5 pecks of seed per acre were used the yield decreased 3 bushels. "It was observed that the thinner the seeding the taller was the straw, and that the thicker the seeding the earlier the oats ripened." The application of barnyard manure increased the yield of grain about 14 bushels per acre, and the yield of straw from 1,500 to 2,500 pounds.

Oats and barley, soil preparation (pp. 47–49).—Improved American oats (10 pecks per acre) and Manshury barley (8 pecks) were each sowed on 12 twentieth-acre plats, without manure.

April 14 and 15, 1891, the 12 plats of each tract were prepared in duplicate in the following manner:

(1) Plowed 7 inches deep and rolled.

(2) Plowed 7 inches deep and harrowed three times—ordinary condition.

(3) Plowed 7 inches deep, harrowed three times, rolled and harrowed three times—seed-bed finely pulverized.

(4) Not plowed; harrowed twice—surface but slightly disturbed.

(5) Not plowed; cultivated once with eight-shovel corn cultivator and harrowed once—surface rather poorly pulverized.

(6) Not plowed; cultivated three times with eight-shovel corn cultivator and harrowed three times—surface soil fairly well pulverized. * * *

The results [as tabulated] do not indicate that there was any material advantage in an extra preparation of the seed-bed over that of plowing and harrowing three times, or over that of plowing and rolling merely.

As was to be expected in this compact soil, the yield of both oats and barley was considerably less where the land was not plowed, the decrease being about the same in both crops (oats, 22.5 per cent; barley, 25 per cent).

Oats, time of seeding (pp. 49, 50).—Japan oats were sown on 10 twentieth-acre plats at weekly intervals between April 8 and May 6. The largest yield of grain was from seeding April 15, and of straw from seeding April 22. Seeding May 6 resulted in a material decrease in the yield of grain as compared with seeding any time in April.

Corn, depth of seed bed (pp. 50, 51).—Eight fifteenth-acre plats were seeded with a medium maturing dent variety of corn, different plats being plowed to depths of from 4 to 10 inches. The results favored plowing 6 inches deep.

Corn, depth and frequency of cultivation (pp. 51–54).—On 8 fifteenth-acre plats corn was cultivated at different depths and with different frequency. The plan and results of the experiment are shown in the following table:

Effect of cultivation of corn at different depths.

Kind of cultivation.	Weight of 100 ears.	Yield of ears per acre.	Weight of stover per acre.	Weight of fodder per acre.
	Pounds.	*Bushels.*	*Pounds.*	*Pounds.*
1. None	37	47	2,400	6,150
2. Hoed	42	54	2,925	7,275
3. Shallow, frequent	44	54	2,700	7,050
4. Deep, frequent	47	56	2,445	6,945
5. Shallow, ordinary	49	60	2,850	7,650
6. Deep, ordinary	48	60	3,150	7,950
7. Shallow, once after usual time	50	59	2,850	7,575
8. Deep, once after usual time	48	54	2,625	6,975
None, 1 plat	37	47	2,400	6,150
Shallow, average 3 plats	48	58	2,800	7,425
Deep, average 3 plats	48	57	2,740	7,290
Frequent, average 2 plats	45.5	55	2,570	7,000
Ordinary, average 2 plats	48.5	60	3,000	7,800
Once after usual time, average 2 plats	49	56.5	2,740	7,275

"The * * * plat in which the soil was not stirred after the corn was planted gave a yield on this compact clay soil of 47 bushels per acre, while three plats cultivated about 2 inches gave an average yield of 58 bushels, and three plats cultivated about 4 inches deep gave an average yield of 59 bushels per acre. * * *

"The results from the plats receiving no cultivation show that stirring this soil is not essential to a fair yield of corn.

"Larger yields of corn and stover were obtained where only ordinary cultivation was given than where the corn was either frequently cultivated, or where it was cultivated after the usual time of laying corn by."

Corn, rate of planting and distribution of seed (pp. 54–58).—An account of an experiment in which a medium maturing variety of dent corn was planted on 24 fortieth-acre plats at six different rates and with five different methods of distribution. The plan and results of the experiment are shown in the following table:

Summary of results with corn planted at different rates.

	Planted at the rate of one kernel to every—					
	3 inches. Average of 5 plats.	6 inches. Average of 5 plats.	9 inches. Average of 5 plats.	12 inches. Average of 4 plats.	15 inches. Average of 3 plats.	24 inches. Average of 2 plats.
Number of kernels planted per acre	49,780	24,890	16,590	12,445	9,955	6,220
Number of stalks harvested per acre	37,690	19,660	13,270	9,600	8,260	6,185
Number of stalks harvested for 100 kernels planted	76	79	80	77	83	99
Number of ears harvested for each 100 stalks	70	87	95	100	97	93
Weight of 100 ears ... pounds	14	32	41	49	52	55
Weight of 100 stalks ... do	25	24	25	26	35	43
Bushels of ear corn, 80 pounds ears per bushel	46	69	65	59	52	40
Weight of stover ... pounds	6,690	4,190	3 175	2,520	2,780	2,440
Weight of corn fodder ... do	10,340	9,690	8,345	7,230	6,430	5,610
Pounds stalk for 100 pounds of ears	183	76	61	53	67	77

So far as the production of ears was concerned the stalks reached their best development when planted at the rate of one kernel every 12 inches, or 12,445 kernels per acre, producing one stalk every 15 inches, or 9,600 stalks per acre. * * *

The largest yield of corn, 69 bushels, was from plats planted at the rate of one kernel every 6 inches in rows 42 inches apart. There were 19,660 stalks produced per acre, which was at the rate of one stalk every 7½ inches. Planting at the rate of one kernel every 9 inches produced 4 bushels less corn per acre from about one third less ears. Planting at the rate of one kernel every 12 inches produced 10 bushels less from only about one half the number of ears. Obviously where the corn is to be husked by hand the cost of gathering the 69 bushels would be considerably more than that of gathering the 59 bushels.

In general the quantity of stover decreased with the decrease in the thickness of planting. The total weight of corn fodder (ear corn and stover) decreased with the decrease in the thickness of planting.

While the total weight of corn fodder was 650 pounds greater where the corn was planted at the rate of one kernel every 3 instead of 6 inches, the weight of ear corn was 1,850 pounds or 23 bushels less from the former than from the latter. In other words 1,850 pounds of ear corn was replaced by 2,500 pounds of corn stover.

There were four thicknesses of planting, at the rate of one kernel every 3, 6, 9, and 12 inches, in which there were four methods of distribution, namely, 1, 2, 3, and 4 kernels per hill. * * * The method of distribution had no practical effect on the yield of corn or stover.

Corn, topping vs. cutting whole stalks or allowing corn to ripen without cutting (pp. 58–60).—An account of an experiment in which the tops of corn stalks were cut off just above the ear September 23, or the stalks

cut off close to the ground at the same date, or the corn allowed to ripen in the field without cutting.

The yields tabulated are for field-cured material. Any variation due to difference in water content is not shown. On account of the stalks being cut at different dates such variations may have existed. With this limitation, the results were as follows:

(1) The weight of one hundred ears was least where corn was cut and shocked when kernels were dented and greatest when corn was allowed to ripen fully before cutting stalks. Topping the stalks reduced the size of the ears.

(2) The largest yield of ears was obtained when corn was allowed to ripen fully before cutting the stalks. The yield of ears was reduced by topping the stalks when the kernels were dented and still more reduced when the whole plant was cut up.

(3) The same general results were obtained from the stover. The top was about one-third the weight of the total stover and only about one-eighth of the total corn fodder. By topping, 1,050 pounds of stover was obtained at a loss of 540 pounds of ear corn per acre as compared with allowing the corn to ripen and merely gathering the ears.

Corn, detasseling (pp. 60, 61).—Between August 3 and 20, in a season of abundant rainfall, the tassels were removed as they appeared from ten alternate rows. The number and weight of ears were not materially affected by detasseling.

Test of varieties of oats, T. F. HUNT and W. H. CALDWELL (*Pennsylvania Sta. Report for 1891, pp. 61–63*).—Tabulated data for 15 varieties grown in 1891 and previous seasons. The most desirable varieties in the tests at the station have been Japan and Improved American.

Time of sowing oats, J. W. SANBORN (*Utah Sta. Report for 1892, p. 131*).—Two years' experiments in sowing oats at different dates showed a marked advantage in early sowing.

Experiments with potatoes, W. H. CALDWELL (*Pennsylvania Sta. Report for 1891, pp. 67–71*).—The experiments with potatoes at the station in 1891 were in the following lines: (1) Test of varieties, (2) amount and kind of fertilizer, (3) rate of planting, (4) preparation of seed. The month of May being unusually dry, the potatoes sprouted very slowly and the stand in many cases was very imperfect.

Test of varieties (pp. 68, 69).—Tabulated data and brief descriptive notes on 16 varieties. The following are recommended as of most promise: Freeman, Green Mountain, Burpee Superior, Ben Harrison, and Monroe County Seedling.

Amount and kind of fertilizer (pp. 69, 70).—Dried blood, dissolved boneblack, and muriate of potash applied on 4 small plats "did not produce any beneficial results on land which had received the usual application of barnyard manure."

Rate of planting (p. 70).—Seed potatoes were planted on 6 small plats at the rate of 10, 12½, and 15 bushels per acre. The medium amount of seed gave the largest yields as regards both total and merchantable product.

Preparation of seed (pp. 70, 71).—Halves, one or two-eye pieces, and similar pieces from tubers having the seed end removed, were compared on 6 plats. The results favored the use of half tubers.

Tillage of potatoes, J. W. SANBORN (*Utah Sta. Report for 1892, pp. 125–128*).—In an experiment continued through three seasons a comparison is made of deep and shallow tillage and no tillage for potatoes. The average of duplicate plats for three years gives the yield of large and small potatoes on shallow-tilled plats as 206.38 bushels per acre; on the deeper tilled plats, 204.87 bushels; and on the untilled plats, 186.7 bushels. Details of cultivation are not given.

Experiments with sugar beets in Iowa, 1892, G. E. PATRICK, W. H. HEILEMANN, and E. N. EATON (*Iowa Sta. Bul. No. 20, Feb., 1893, pp. 690-705*).

Synopsis.—A continuation of coöperative work with farmers in the study of sugar beet culture. The conclusion is drawn that beets of good quality for the manufacture of sugar can be grown in certain portions of Iowa.

Previous work in this line has been reported in Bulletins Nos. 15 and 17 of the station (E. S. R. vol. III, p. 782; IV, p. 144). Beet seed was distributed by the station to farmers in different parts of the State. Eighteen farmers sent samples of beets to be analyzed in the station laboratory.

The season was generally unfavorable because of the wet and backward spring, and the seed was deficient in germinating power. Tabulated data are given for the weight of largest and smallest beets in each sample, the estimated yield of beets per acre, dates of planting and harvesting, per cent of sugar in the beets and in the expressed juice, solids in the juice, and location of the grower.

The samples from farmers averaged 11.60 per cent of sugar in the beets, with a purity coefficient of 72.91. The best sample gave 15.78 per cent of sugar in the beets, with a purity coefficient of 81.02.

The beets grown on the station farm gave 13.62 per cent of sugar, with a purity coefficient of 78.33. The average weight of beets grown by farmers was 20.5 ounces; by the station, 13 ounces.

The average loss in trimming the beets grown by farmers was 15 per cent; by the station, 12 per cent. This smaller loss on the college farm is attributed to deep plowing and to keeping the crowns covered by hilling up the dirt.

A sample of immature beets received September 6 gave only 7.13 per cent of sugar in the roots, with a purity coefficient of 62.5.

Reports from growers are tabulated, and embrace descriptions of soil, manuring, previous cropping of land, and distance between the beets.

The three varieties of beets, Vilmorin, Klein Wanzleben, and Desprez, were compared in thirteen instances. The average size of the beets of the 3 varieties was very nearly the same. Vilmorin and Des-

prez averaged nearly the same in percentage of sugar and purity, while the Klein Wanzleben was a little higher in both respects.

Experiments with sugar beets, H. H. NICHOLSON and T. L. LYON (*Nebraska Sta. Bul. No. 27, Mar. 10, 1893, pp. 1–26, plates 3, figs. 2, charts 6*).

Synopsis.—These experiments embrace (1) preserving beets through the winter, (2) methods of topping beets, (3) experiments with fertilizers, (4) cost of transplanting, (5) rotation, (6) comparison of fall and spring preparation, (7) varieties, (8) large and small seed, (9) heavy and light seed, (10) effect on germination of soaking seed, (11) distance between rows, (12) changes in the beet during growth and maturity, and (13) growing beets from buds. All the methods of storing beets resulted in a loss of sugar content and in the decay of some of the beets. Topping before the roots were taken from the ground required less labor than topping after the beets were laid in piles or rows. The amounts of fertilizer applied were generally unprofitable. There was a financial loss in perfecting the stand by transplanting young beets. Millet proved a good crop to precede beets. Fall preparation was superior to spring preparation. Desprez variety gave the largest tonnage. Large beet seed gave better results than small, and heavy seed gave better results than light. Dry seed germinated better than soaked seed. Eighteen and 15 inches between the rows proved better distances than 24 inches.

Preserving beets through the winter (pp. 1–11).—Four lots of beets were stored October 29 and opened in the latter part of the next April. Lot 1 (variety Lemaire) was piled on the surface of the ground, the pile being 4 feet wide and 3½ feet high. The beets were covered with a thin coating of straw and earth. The pile was topped with straw. A pipe from the top to the middle of the pile allowed the temperature of the heap to be taken at intervals through the winter. When opened about one-eighth of the beets had decayed, those near the surface suffering most. The average sugar content had fallen from 13.8 when the beets were stored to 11.4, a loss of 2.4 per cent.

Lot 2 (variety Desprez) was stored in the same manner as the first lot, except that a box ventilator, with holes in top and sides, was placed on the surface of the ground and the beets piled up over it. In this lot the sugar content fell from 12.1 to 7.4 per cent, a loss in sugar of 4.7 per cent.

Lot 3 was placed in a trench 3½ feet wide and 2 feet deep, the pile extending to a height of about 2½ feet above the surface of the ground. Straw and earth were used as covering. The trench was ventilated by a box ventilator. When opened, the beets in the trench at the end farthest from the ventilator had suffered a loss of only 0.1 per cent of sugar. Near the ventilator the beets were badly decayed, nearly the entire lot being spoiled. The loss in sugar content of the sound beets in this end was 1.5 per cent.

Lot 4 was stored in the same way as lot 3, except that there was a ventilating box running lengthwise along the bottom of the trench, terminating at one end in an upright shaft. In this the variety Klein Wanzleben was placed. When opened, about one-tenth of the whole number had decayed. Those farthest from the upright ventila-

tor were in the best condition. The average loss of sugar was 2.8 per cent. The temperatures in the heaps and outside are recorded for each lot.

Treatment of plats and meteorological conditions (pp. 5–11).—Notes on the weather and care of the plats.

Methods of topping beets (p. 11).—The time required for one man with a hoe to top an acre of beets before the roots were taken from the ground was eleven hours, while the time required for the same work by the use of a sharp corn knife after the beets were drawn and laid in rows was seventeen hours.

Production of seed (pp. 12, 13).—The method of selecting beets rich in sugar for the production of seed is described. The beets were divided into three classes by the following method: A section of the tap root where it was about the size of the finger was taken and its specific gravity tested by throwing it into aqueous solutions of common salt having specific gravities of 1.0612, 1.0548, and 1.0504. The beets which showed a higher specific gravity were tested by means of a polariscope, after which another selection was made based upon true sugar content.

Experiments with fertilizers (pp. 13, 15).—Tables give the amount and kind of fertilizer, the yields, percentage of sugar, purity, pounds of sugar per acre, cost of fertilizers, value of beets and loss or gain per acre from using fertilizers.

From the tables it appears that the effect of fertilizers was variable, and that in most cases the amounts applied were unprofitable.

Transplanting (pp. 15, 16).—In a plat of 1 acre the vacant spaces in the rows caused by the failure of the seed to germinate or by injury from rains were filled in with young plants of the same variety taken from another part of the field and placed at the usual distance in the rows. The difference in the cost of raising beets on this plat and on the remainder of the field planted with the same amount of seed per acre is compared with the value of the increased product of this acre over the general average. The increased expense on the area where some plants were transplanted was $22.91; the increased value on this acre was $17.04, leaving a loss of $5.87 as the result of transplanting. However, the author considers that meteorological conditions were unfavorable to the transplanted area.

Rotation (pp. 16, 17).—The yield, purity, and per cent of sugar of beets grown after millet, buckwheat, corn, and beets were compared. The following table gives the results:

Results of experiments with sugar beets in rotation.

Previous crop.	Yield of beets per acre.	Sugar in beets.	Purity.
	Tons.	*Per cent.*	
Millet	12.0	14.0	81.3
Buckwheat	12.1	12.4	79.3
Corn	7.0	12.6	78.7
Beets	10.5	13.1	79.6

Millet gave the best results as a predecessor of beets, leaving the ground in excellent physical condition and comparatively free from weeds. The smallest yield of beets was after corn.

Fall and spring preparation (pp. 17, 18).—Two sets of plats were plowed in the fall; one of these was replowed in the spring, the other simply harrowed with a disk harrow and smoothed with a drag and float. The yield of beets, sugar content, and purity were practically the same on both.

Other plats which were plowed and subsoiled in the fall yielded 4 tons of beets per acre in excess of the plats which were plowed and subsoiled in the spring.

Test of varieties (pp. 18, 19).—The following varieties were grown: Vilmorin, Lemaire, Knoche Improved Klein Wanzleben, Klein Wanzleben, and Desprez. Desprez gave the largest tonnage, but the recorded results are vitiated by imperfect germination of the seed and by injuries from heavy rains.

Size and density of seed (pp. 19–21).—By means of sieves, two lots of seed, one the largest, the other the very small seed, were secured. The latter lot contained all the dried up and shriveled seed. The actual yield from the larger and more perfect seed was 5.3 tons greater per acre than that from the imperfect seed. The excess in sugar content which was also in favor of the beets from the larger seed was 1 per cent. Both lots gave the same purity coefficient.

To separate seeds with a higher specific gravity from those less dense, the seed was immersed for a moment in alcohol of about 80 per cent purity. This did not affect the germinating power of the seed, though soaking for half an hour destroyed the germinating power. The seeds which sank as soon as thrown into the alcohol were planted on one plat, while the lighter seeds which floated were planted on another. The yields of the crops were not recorded. The light seed gave a sugar content of 11.3, the heavy seed 14.3. The light seed gave a purity coefficient of 77.3, and the heavy seed 80.2.

Effect on germination of soaking seed (pp. 21, 22).—In a very dry soil were sown dry seed, and seed which had been soaked in water six hours and twenty-four hours, respectively. Six days later another lot which had been soaked for twelve hours in equal parts of urine and water was sown in dry soil. Only the seed which had been soaked in water failed to germinate.

Distance between rows (pp. 21, 22).—The yield, sugar content, and purity of the beets grown on plats on which the rows were respectively 24, 18, and 15 inches apart are tabulated. The last two distances gave larger yields than 24 inches.

Changes in the beet during growth and maturity (pp. 23, 24).—Samples of beets and leaves were analyzed at intervals of ten days, beginning July 10 and ending December 12. The analyses are tabulated, and show at different dates the weight of beets, leaves, roots, crowns, and bodies;

the specific gravity, water content, and dry matter of crowns and bodies the specific gravity, Brix reading, apparent water, true water, dry matter, ash, sugar, nitrogen, apparent purity, and true purity of the juice from the crowns and bodies of beets.

Growing beets from buds (p. 25).—These experiments began in the autumn of 1891. High grade beets were selected, the buds started, removed from the beet and placed in the greenhouse, from which after rooting they were moved to the garden. A figure is given showing a specimen of beets so raised. This work will be continued.

A study of the growth of root crops, W. H. CALDWELL (*Pennsylvania Sta. Report for 1891, pp. 33–43*).—Sugar beets (Vilmorin Improved) and mangel-wurzels (Long Red and Harris Yellow Globe) were seeded at two different rates, April 22 and May 6 and 20, on plats manured with dried blood (600 or 1,200 pounds per acre), muriate of potash (200 pounds), and dissolved bone black (100 pounds), and on others unmanured. The rates of seeding were somewhat irregular, but averaged 13.2 and 6.7 pounds per acre. The plants on the thick-seeded plats were thinned to 6 inches apart and on the thin-seeded plats to 12 inches. Tabulated and other data are given for yield and cost of crop.

The following summary of results is taken from the Report:

The advantage of early over later seeding was forcibly demonstrated by the fact that there was a gain in yield of from 3,000 to 5,000 pounds per acre in each of the first two plantings over the succeeding one of the sugar beets, and the first two plantings of both kinds of mangel-wurzels. Between the last two seeding of mangel-wurzels the difference was far greater, being from 6,000 to 12,000 pounds per acre.

There was a marked advantage in the use of the larger amounts of seed. Aside from the increased yield per acre of the thick-seeded plats there were plenty of good strong plants where needed at the time of thinning, which obviated transplanting with accompanying loss of vigor and time for growth.

There was a profit of from \$10.28 to \$76.64 by the use of a mixture of commercial fertilizers containing a large amount of nitrogen, and from \$14.21 to \$66.01 by the application of a mixture containing a liberal amount of plant food with mangel-wurzels.

With sugar beets the application of commercial fertilizers did not pay in four of the twelve instances.

The cost of producing the sugar beets was \$8.97 a ton; of the Yellow Globe mangel-wurzels \$6.89; and of the Long Red mangel-wurzels \$5.96.

Mangel-wurzels are much preferable to sugar beets, for farmers to raise as stock food, particularly on a close, compact, clay soil.

Early seeding facilitated early weeding and thinning, thus lessening the expense of after cultivation of the crop.

Tobacco, A. J. BONDURANT (*Alabama College Sta. Bul. No. 44, May, 1893, p. 42*).—A treatise on tobacco. The general discussion of the subject is introduced by remarks on the propagation of plants in beds covered with cloth. The topics treated at length in this bulletin are the botanical characteristics of tobacco and the climatic conditions required by the plant; cultivating and transplanting the plants; chemical properties; fertilizers for tobacco; insect pests; varieties; harvesting and curing; Snow's modern tobacco barn; and stripping, prizing, casing, and baling tobacco.

Test of varieties of wheat, W. H. CALDWELL (*Pennsylvania Sta. Report for 1891, pp. 63–66*).—Tabulated data and descriptive notes on 28 varieties grown at the station from one to six years. Dietz Longberry Red and Fulcaster gave the best results.

Harvesting wheat, J. W. SANBORN (*Utah Sta. Report for 1892, pp. 64–66*).—The yields of wheat cut when in bloom, in early milk stage, in early dough stage, in full dough, when dried to center, when hard to center, when ripe, and when overripe are recorded for the seasons of 1890, 1891, and 1892. The time of harvesting the crop on each plat was changed each season. The plats received three irrigations each season.

The following table gives the average yield and other data for three years, except that the yields when the grain was "dry to center" are the averages for only two years:

Average yield of wheat per acre and ratio of straw to wheat.

Period of harvesting.	Yield of grain per acre.	Yield of straw per acre.	Amount of straw for each bushel of grain.	Total yield of grain and straw per acre.
	Bushels.	*Pounds.*	*Pounds.*	*Pounds.*
At bloom	....	2,213	....	2,213
At milk stage	3.06	1,926	250	2,110
Early dough stage	10.8	1,770	164	2,420
Full dough	15.0	1,653	169	2,556
Dry to center	18.4	1,600	144	2,706
Hard to center	18.8	1,600	141	2,733
Ripe	20.7	1,800	144	3,044
Overripe	16.2	1,693	....	2,669

The overripe grain was lost by shattering, and the ripe grain also suffered some loss in this respect.

The table shows a constant increase in the yield of grain up to and including the ripe stage. The increase of total weight of straw and grain, from bloom to the ripe stage, amounted to 34.5 per cent.

Field experiments with wheat, J. W. SANBORN (*Utah Sta. Report for 1892, pp, 121–125, 129–131, 133–135*).—*Rolling wheat* (pp. 120–122).—In an experiment conducted during 1891 and 1892 the land for wheat was rolled before and after seeding and after the wheat crop was up. The following table gives the average yield for the two years:

Effect of rolling wheat.

	Average yield per acre for two years.			Amount of straw for each bushel of grain.
	Grain.	Straw.	Total yield of grain and straw.	
	Bushels.	*Pounds.*	*Pounds.*	*Pounds.*
Unrolled	13.77	1,240	2,066	90.05
Rolled before seeding	11.00	1,273	1,933	115.80
Rolled after seeding	18.20	1,540	2,633	84.61
Rolled after seeding and after crop was up	12.44	1,486	2,232	119.45
Unrolled	13.90	1,000	1,833	71.93

The best yield was secured by rolling after seeding.

"The tests for moisture for two years showed in the upper 3 inches of soil of the unrolled section 4.14 per cent of moisture; and of the rolled, 5.03 per cent. The plats were rolled May 19, and irrigated June 14 and 27." The following table shows the soil temperatures at different dates:

Soil temperatures (degrees F.) of rolled and unrolled plats.

	June 7.		June 14.			June 28.	
	Surface.	3 inches deep.	Surface.	1 inch deep.	3 inches deep.	Surface.	1 inch deep.
Rolled plats	77	69.8	69.8	77.0	68.0	98	96
Unrolled plats	84.2	69.9	84.2	73.4	64.4	96	94

These experiments will be continued.

Hoeing wheat (pp. 122–125).—This experiment was continued three years. In order to hoe successfully, every other row sown by the grain drill had to be cut out. The plat without hoeing did not have this extra row cut out in 1890 and 1891, and hence this plat can be compared with the others only in 1892 when it had the same stand. The following table shows the results of hoeing wheat 1, 2, 3, and 4 inches deep:

Effect of different depths of hoeing on the yield of wheat.

Depth of hoeing.	Average yield per acre.			Amount of straw for each bushel of grain.
	Grain.	Straw.	Total yield of grain and straw.	
	Bushels.	*Pounds.*	*Pounds.*	*Pounds.*
1 inch	12.27	1,153	1,889	93.96
2 inches	*14.66	*1,120	*2,000	*70.93
3 inches	9.23	633	1,223	71.06
4 inches	8.82	560	1,089	63.49

* Average for two years.

Omitting the plat hoed 2 inches deep, the results of which are given for only two years, and the untilled plat, the averages for the three years show that the yield of both grain and straw decreased as the depth of hoeing increased.

In 1892, when all the plats were comparable, hoeing 1 inch deep gave the largest yield of grain, 83 pounds per plat; hoeing 2 inches deep gave 73 pounds; 3 inches, 58 pounds; and 4 inches, 51 pounds; while the plat not hoed gave 76 pounds of wheat.

The author concludes that hoeing to the depth of 2 inches does not materially affect the crop.

Soil from the plat not hoed contained for the first inch of soil 1.20 per cent of moisture, and for the first 3 inches 3.54 per cent. Soil from the plat hoed 1 inch

deep contained for the first inch 1.24 per cent of moisture, and for the first 3 inches 6.24 per cent. The plat hoed 2 inches deep contained for the first inch 1.04 per cent of moisture, and for the first 3 inches 3.58 per cent.

The above was taken on July 14. A subsequent test was made and the plat not hoed for the first inch gave 7.01 per cent of moisture; for the first 3 inches, 9.77 per cent; the plat hoed 1 inch deep gave for the first inch 7.56 per cent; for the first 3 inches, 9.22 per cent; the plat hoed 2 inches deep gave for the first inch 5.68 per cent; for the first 3 inches, 6.81 per cent. The averages are 4.10–6.65 per cent for no hoeing, 4.40–7.73 per cent for hoeing 1 inch deep, and 3.36–5.09 per cent for hoeing 2 inches deep.

The following table shows the soil temperatures at the surface, 1 inch below the surface, and 3 inches below the surface at different dates:

Soil temperatures (degrees F.).

Depth of hoeing.	Surface soil.			1 inch deep.			3 inches deep.		
	June 18.	June 30.	July 12.	June 18.	June 30.	July 12.	June 18.	June 30.	July 12.
No hoeing	92	85	93	89	91	85	77	90	78
1 inch	99.5	90	90	84	86	80	76	82	72
2 inches	101	94	100	86.5	92	90	86	86	85
3 inches	104	88	103	95	90	88	83	85	82
4 inches	109	84	112	96	92	97	79	86	85

Time and method of sowing wheat (pp. 129, 131, 132, 133).—The average of three years' experiments in sowing wheat at different dates favors sowing in April rather than in March or May.

In a three years' test of methods of sowing wheat, a slightly larger yield of grain resulted from drilling than from broadcasting. In broadcasting, 6 pecks per acre gave a larger yield of both grain and straw than 8 pecks. On one plat, every other drill was removed and the yield was largely reduced by the greater distance between drills.

Selection of seed wheat (pp. 133–135).—An experiment in seeding large, medium, small, shriveled, dense, and light kernels was extended through three years. The results, which were unsatisfactory to the author, are tabulated.

Varieties of wheat, oats, and barley, A. A. MILLS (*Utah Sta. Report for 1892, pp. 171–189*).—*Wheat* (pp. 171–177).—Tabulated data for 33 varieties, most of which were grown two years and a few three years. "Of the varieties tested for two seasons or more, Northcote Amber takes the lead in yield, with Gypsum, Beryl Ruby, Granite, Australian Club, and the common Touse following in the order named, Ruby and Granite yielding the same. Improved Fife is a good grain [being second in 1892], but it was grown only one season.

"Seven varieties gave better yields than did our common Touse wheat, all maturing within a few days of the Touse—some earlier and some later.

"Of the eight best yielders Improved Fife and Australian Club were the earliest to mature, being five days earlier than the common wheat."

Oats (pp. 178–185).—Tabulated data for 27 varieties, most of which

were tested for three years. White Belgian, Clydesdale, and Race Horse were the earliest to mature, in the order named.

Barley (pp. 186–189).—Nine varieties were tested. The yields of the same variety varied greatly in the three years of the test. The highest yield for a single year, 59.62 bushels, was made by the Lump Blue variety.

General fertilizer experiments, W. H. CALDWELL (*Pennsylvania Sta. Report for 1891, pp. 71–91*).—The yields of corn, oats, wheat, and grass in 1891 on the four tiers of 36 eighth-acre plats laid out for rotation experiments in 1881 are tabulated. For previous accounts of this experiment see the Annual Report of the station for 1890 (E. S. R., vol. III, p. 718).

Methods of plowing and harrowing, J. W. SANBORN (*Utah Sta. Report for 1892, pp. 91–107*).—*Depth of plowing* (pp. 91-96).—The following table gives the results of an experiment continued through three seasons and having for its object the determination of the best depth of plowing:

Average yield per acre of wheat on duplicate plats plowed to different depths for three years.

Depth of plowing.	Wheat.	Straw.	Total of wheat and straw.
	Bushels.	*Pounds.*	*Pounds.*
4 inches	14.1	1,101	1,950
6 inches	13.3	1,113	1,914
Not plowed	8.6	1,013	1,531
8 inches	14.7	1,117	1,999
10 inches	14.4	1,317	2,131

A difference in the depth of plowing has not materially affected the yield of wheat. The amount of straw increased constantly but slightly with the depth of plowing. The percentage of moisture was determined to a depth of 8 inches on all the plats; the unplowed plat showed most moisture, 6.74 per cent; that plowed 4 inches deep gave the least, 5.52 per cent.

Width of furrow (pp. 96-100).—In a trial extending over three years there was no essential difference in the yield of wheat on plats which had been prepared with furrows 8, 12, and 16 inches wide. The ratio of straw to grain varied somewhat, being least when the furrows were 8 inches wide, and greatest when they were 12 inches wide. The percentages of moisture on the plats plowed 8, 12, and 16 inches were respectively 5.50, 5.72, and 4.51. All plats were irrigated three times.

Time of plowing (pp. 100–103).—The following table gives the average of duplicate plats plowed at different dates in 1891 and 1892:

Effect of plowing at different dates.

Date of plowing.	Average yield per acre for two years.			Amount of straw for each bushel of grain
	Grain.	Straw.	Total yield of grain and straw.	
	Bushels.	*Pounds.*	*Pounds.*	*Pounds.*
September	17.33	1,560	2,600	90.00
October 15	15.33	2,247	3,167	146.56
December 5	16.90	1,287	2,300	76.15
March 12	14.11	1,920	2,767	136.07
April 20	18.77	1,740	2,866	92.70

Surface tillage trials (pp. 103–107).—Under this head is recorded an experiment, repeated in 1890, 1891, and 1892, on the effect of different methods of preparing the seed bed for wheat. "A loamy soil, tending strongly to sandy loam," was used. The following table gives a summary of the results secured:

Effect of different methods of preparing the seed bed for wheat.

	Average yield per acre for three years.		
	Grain.	Straw.	Grain and straw.
	Bushels.	*Pounds.*	*Pounds.*
Unplowed but harrowed	*8.77	†946	*1,472
No harrowing	12.22	1,170	1,904
Harrowed once	11.57	1,626	2,220
Ordinary harrowing (three times)	11.48	1,555	2,265
Excessive harrowing (seven times or more)	10.07	1,861	2,465
No harrowing	10.02	1,797	2,598
Square-tooth harrow	*13.88	*2,533	*3,367
Cutaway harrow	14.78	2,446	3,332
Cutaway harrow used excessively	12.77	2,633	3,399
Plowed, not harrowed, dragged level	16.33	1,920	2,900

*Average of 1891 and 1892. †Yield in 1892.

Storage of green vs. dry food (*Utah Sta. Report for 1892, pp. 40–49*).—The loss in storing corn fodder in a dry state and in a green state in three different silos was determined. The station silo was divided into four equal sections, each 8 by 11 feet. Silos 1 and 2 were filled with green corn fodder and silo 3 with corn stover. Silo 4 was filled with alfalfa and Hungarian grass. Silo 1 was weighted with rocks and then covered with sawdust; silo 2 was not weighted, but was covered with plank and a 4-inch layer of sawdust. The losses from ensiling were compared with those in corn fodder stored dry. "Neither the cut nor whole alfalfa gave satisfaction as silage."

There was apparently a greater loss of dry weight of the weighted than of the unweighted silage, but an uncertain element was involved.

The changes in the mass by fermentation were apparently more unfavorable for the unweighted.

The loss of dry matter in the two silos averaged 17.1 per cent.

The loss in dry storage, although the heaviest in the experience of the writer and avoidable, was 25.1 per cent.

The changes in the composition of dry stored corn fodder were decidedly less important than for that preserved in the silo. None of it was spoiled.

Corn fodder stored in the silo in air-dried condition (dried for two weeks), kept the best of the several lots, had none spoiled, showed no less by analysis, while by the eye there was evidence of its having been kept in an ideal condition. It was well eaten by stock. The success by this method exceeds any secured by other methods heretofore tried and was undoubtedly superior in this instance to green storage.

A preliminary trial is also reported on the loss of hay stored in a bag suspended, and in the center of a mow.

HORTICULTURE.

Notes on varieties of orchard and small fruits and vegetables, G. C. BUTZ (*Pennsylvania Sta. Report for 1891, pp. 137–160*).—Descriptive notes and tabulated data for 28 varieties of pears, 26 of apples, 22 of plums, 13 of strawberries, 15 of raspberries, 8 of blackberries, 7 of currants, 10 of grapes, 14 of bush beans, 3 of pole beans, 6 of beets, 22 of cabbages, 12 of sweet corn, 14 of lettuce, 15 of peas, and 14 of tomatoes

Report of horticulturist of Utah Station for 1892, E. S. RICHMAN (*Utah Sta. Report for 1892, pp. 139–163*).—A list is given of species of trees and shrubs planted at the station during the year. There are also notes on 29 varieties of grapes, 8 of peaches, 8 of raspberries, 6 of blackberries, 2 of dewberries, 60 of strawberries, 3 of gooseberries, 47 of cabbages, and 35 of lettuce. The following summary is taken from the bulletin:

Grapes of the Herbemont and Cynthiana type (*æstivalis*) are not adapted to this latitude and altitude. Grapes of the Concord (*labrusca*) and Empire State (*riparia*) type can be grown successfully here; also their hybrids.

Early maturing grapes and peaches are best adapted to this locality.

Lovett Early is the best early strawberry and Parker Earle the best medium and late, so far as yet determined.

The Downing gooseberry is the most promising kind.

Landreth Earliest is the most satisfactory early cabbage, and Burpee All Head the largest. Newark Early Flat Dutch, New York Early Summer, Maule Midsummer, Maule Prize Flat Dutch, and Premium Large Late Flat Dutch are promising later varieties of cabbages.

Early Prize Head lettuce is one of the most desirable varieties. Other varieties may remain usable longer, but none are better or finer in general appearance.

Analyses of chestnuts, W. FREAR (*Pennsylvania Sta. Report for 1891, pp. 193–178*).—A reprint from Bulletin No. 16 of the station (E. S. R., vol. III, p. 177).

Chestnut culture for fruit, W. A. BUCKHOUT (*Pennsylvania Sta. Report for 1891, pp. 165–172, plate 1*).—A reprint from Bulletin No. 16 of the station (E. S. R., vol. III, p. 177).

FORESTRY.

Forest fires, W. A. BUCKHOUT (*Pennsylvania Sta. Bul. No. 23, April, 1893, pp. 1–8, plate 1*).—A popular statement of the loss occasioned by forest fires, their origin, and the means suggested to enforce the laws on the subject. The text of the acts of the State legislature passed June 2, 1870, and June 11, 1879, is given. Starting of fires on the lands of another, resulting in the destruction of woodland, is made a misdemeanor, the penalty being a fine not exceeding $300, or twelve months imprisonment, or both.

Experience with evergreens in Pennsylvania, G. C. BUTZ (*Pennsylvania Sta. Bul. No. 23, Apr., 1893, pp. 8-17, plate 1*).—In 1860 the following species of evergreens were planted upon the college grounds: *Pinus austriaca, P. mitis, P. pinaster, P. laricio-corsica, P. halepensis, P. pinda, P. pumilis, P. sylvestris, Larix europea, Sequoia gigantea, Juniperus nana, J. thurifera, J. oblonga pendula, J. oblonga fragrans, J. oblonga alba, J. prostrata, J. recurva, J. religiosa, J. stricta, J. squamata, J. sabina cupressifolia, J. sabina variegata, J. virginiana pendula, J. communis hibernica, J. chinenis, J. japonica, J. occidentalis, Picea nigra, P. excelsa, Abies balsamea, A. pectinata, Thuya siberica*, and *T. occidentalis.* Of these only the following remain, the others having mostly disappeared before 1870: *Pinus austriaca, P. sylvestris, Larix europea, Picea nigra, P. excelsa, Abies balsamea, A. pectinata, Juniperus communis hibernica*, and *J. oblonga pendula.*

The following species of conifers indigenous to Pennsylvania are popularly described: Balsam fir (*Abies balsamea*), red cedar (*Juniperus virginiana*), juniper (*J. communis*), black larch (*Larix americana*), black spruce (*Picea nigra*), Jersey or scrub pine (*Pinus inops*), table mountain pine (*P. pungens*), red pine (*P. resinosa*), pitch or yellow pine (*P. rigida*), white pine (*P. strobus*), American yew (*Taxus baccata canadensis*), hemlock (*Tsuga canadensis*), and American arbor vitæ (*Thuya occidentalis*).

Notes are given on the habits and value of the following additional species grown on the college grounds: Nordman's fir (*Abies normannia*), silver fir (*A. pectinata*), Chinese arbor vitæ (*Biota orientalis*), Lawson's cypress (*Cupressus lawsoniana*), Chinese juniper (*Juniperus chinensis*), Irish juniper (*J. communis hibernica*), weeping juniper (*J. oblonga pendula*), western juniper (*J. occidentalis*), European larch (*Larix europea*), white spruce (*Picea alba*), Norway spruce (*P. excelsa*), Austrian pine (*Pinus austriaca*), heavy wooded pine (*P. ponderosa*), Scotch pine (*P. sylvestris*), Japan cypress (*Retinospora obtusa*), golden pea-fruited cypress (*R. pisifera aurea*), *R. squarrosa*, maidenhair tree (*Salisburia adiantifolia*), umbrella pine (*Sciadopytis verticillata*), bald cypress (*Taxodium distichum*), Tom Thumb arbor vitæ (*Thuya occidentalis elwangeriana*), and Siberian arbor vitæ (*T. occidentalis siberica*).

SEEDS.

WALTER H. EVANS, *Editor.*

Should farmers raise their own vegetable seeds? G. C. BUTZ (*Pennsylvania Sta. Report for 1891, pp. 160–164*).—A report on experiments in continuation of those recorded in Bulletin No. 10 and the Annual Report of the station for 1889 (E. S. R., vol. II, p. 28; III, p. 461). Notes and tabulated data are given for comparisons of seeds of tomatoes grown at the station with those purchased from a seedsman. A larger percentage of the station seeds germinated, and the yield also somewhat favored these seeds, but earlier fruit was obtained from purchased seed.

DISEASES OF PLANTS.

WALTER H. EVANS, *Editor.*

Œdema of the tomato, G. F. ATKINSON (*New York Cornell Sta. Bul. No. 53, May, 1893, pp. 77–108, plates 8*).—During the latter part of 1892 it was noticed that one variety of tomatoes in the forcing house presented a very peculiar aspect. The leaves were curved and the leaflets turned so as to expose the lighter color of their under surface. The appearance of the plant was that of a recently transplanted one. When closely examined the midribs, petioles, and surface of the stem presented a frosty appearance not unlike the conidial phase of some of the mildews. A microscopic examination showed a very different condition from what was suspected. A section through one of the cushion-like areas showed that—

The epidermal cells were very much enlarged, while the chlorophyll-bearing cells just beneath, as well as some of the more deeply seated cells, were greatly elongated in a radial direction and strongly clavate at their outer extremity where this extended beyond the lateral pressure from adjacent tissue. In many cases the epidermal cells quickly separate and slough off. The cells of the affected areas possessed exceedingly delicate walls, so that with little disturbance they would collapse. There was little protoplasm in proportion to the size of the cell, and a corresponding amount of cell sap. Several of the notable phenomena coincident with the development of these cushions of abnormally turgescent tissue are explained by this peculiar physical derangement of the normal cell structure. The frosted or whitened aspect of the cushions results from the small amount of chlorophyll in proportion to the leaf surface. The amount of chlorophyll in the individual cell remains the same, while the grains are far separated in their distribution throughout the greatly enlarged cell. The curling upward of the leaves results from the greater lateral pressure which exists in the cells of the lower surface of the veins. * * *

The primary effects of this derangement of the tissue, farther than is pointed out above, relates to certain interferences with the life and nutrition of the plant which are manifestly attributable to it. When the cell walls have become so inordinately stretched that they suddenly collapse, as frequently happens, the changes brought about by the escape of water from this and adjacent tissues during the warmer part of the day may be so profound as to cause the leaf to wilt and die. In other cases the cushions, when collapsed, soon dry without great loss of water from adjacent

tissues, but the injury is so deep it seriously disturbs the nutrition of that part of the leaf, as shown by a yellowing of the upper surface at this point. Numerous points of attack on the venation of the lower surface of the leaf in such cases gives to the upper surface a spotted appearance, while the dried cushion immediately below presents a tomentose appearance. Although in such cases the entire leaf is usually curled upward, the points of injury are more strongly arched, which produces upon the upper surface of the leaf a depressed area within the yellow spots.

The secondary effects of the trouble relate to profound changes which sometimes follow, but which are not so manifestly attributable in all cases, at first examination, to this derangement of the tissues. Frequently, when the leaf does not wilt after the collapse of the cushion, the broken and dying tissues encourage the development of putrefactive germs which set up fermentations that affect adjoining tissues, and the leaf is slowly disorganized. Discoloration of the tissue accompanies these morbid phenomena, and while they proceed also through the very succulent parenchymatous tissue of the petiole and down the stem, there appear elongated, depressed, blackened areas, which eventually reach the vascular tissue of the stem.

Frequently such morbid changes originate from cushions developed on the stem, and there is reason to believe that sometimes quite extensive areas of hypodermal tissue of the stem are stretched enormously and induce similar destructive metabolism when the epidermis has become too firm for its individual cells to participate in such change.

When the development of the cushions is confined mainly to the mesophyll areas of the leaf, or to the very small veinlets, or at their terminations, they rapidly collapse and the morbid changes succeeding in the mesophyll extend over areas of various sizes, which in the early stages are yellowish in color. In these secondary effects many of the very small young leaves are affected at the apex, frequently the entire apex being involved, and on the somewhat larger leaves it may be confined chiefly to the base of the leaf, or the severity of the attack is located there. The progress of this yellow color indicates failing nutrition, which is augmented by the interference produced from the diseased areas in the stem. It terminates in the death of the tissues involved, which then change to a dirty grayish-brown color. The veinlets involved become much darker in color, being nearly black, so that viewed through a pocket lens the grayish-brown patches show frequently cross lines of black or borders of the same color.

The inquiry as to the cause of this abnormal condition was carried on by the author for a considerable time. The superficial resemblance to some fungus diseases and to the erineum developed on certain leaves led to their consideration, but it was quickly seen that the trouble was not due to such causes. A bacterial disease was next thought of, and two lines of investigation were carried out having in view the discovery of the germ. The first was by inoculation with diseased material. Five separate experiments were tried with a considerable number of plants, but without result. By isolation and cultures fifteen species of bacteria were obtained, viz, three of *Bacillus*, three of *Micrococcus*, and nine of *Bacterium*. Inoculations were made upon the healthy plants with liquid cultures of all these species, but without result.

The negative results, together with the peculiar stretching of groups of cells to eight or ten times their normal size, suggested that the trouble was of physiological origin, and that the expansion was due to the turgescence of the cells, caused by an excess of root pressure over transpiration. That currents of air aid transpiration, that humidity of the atmosphere checks it, and that it is less active at night than in day-

light are well-known principles. By the structure of the forcing house all these conditions were favorable to a diminished transpiration. Again, the almost equal temperature of the soil and air would decrease the transpiration without influencing the root pressure.

Since turgescence is mainly dependent upon root absorption for the supply of water and a turgid condition of the plant soon follows strong root pressure unless transpiration is taking place rapidly, it has become customary to say that root pressure causes turgidity. Of course, it is understood that this is not the immediate cause. Water cannot be pressed into a cell and cause turgescence. The cell wall is permeable and as rapidly as water can be driven in at one side it will filter out at the other. The protoplasmic utricle which lines the cell wall is not permeable, or at least only to a small degree. The water, then, which passes into the cell through the protoplasmic utricle, cannot filter out, and when it does not escape by evaporation or excsmose from the surface, it stretches the protoplasmic utricle, presses it against the elastic cell wall, which then yields and the cell is turgid. The extent to which the cell wall is stretched depends upon the endosmatic activity which introduces water into the cell, the rate of transpiration and the firmness of the cell wall. The endosmatic activity within the cell is brought about by the presence of certain salts or organic acids in the cell sap which have a strong affinity for water.

By root absorption the plant is supplied with water, the permeable cell wall permitting it to flow from the vascular bundles into the fundamental and other tissues where it comes in contact with the protoplasmic membrane lining the cell wall. When root absorption is active and transpiration is inactive or at a low ebb, the affinity which the vegetable acids possess for the water draws it within the cells. Root absorption practically being in operation continuously under the conditions of the forcing house, and transpiration being in operation for such a large part of the time, the cell walls are unduly stretched. This continues until a point is reached where the normal tissue tension is overcome and the fundamental tissue of the leaf or the cortical parenchyma of the stem is no longer held in longitudinal tension. The cell wall thus continuing to stretch, yields at the point of least resistance, which is at the surface of the conjested tissue and the radial elongation of the cells, is the result.

The presence and increase of organic acids in the plant has been proved by several investigators to be an important factor in causing turgescence of tissues. These acids are rapidly formed at a temperature varying from 50° to 57° F., about the temperature of the house, and are decomposed at a higher temperature. The production of carbohydrates is largely dependent upon the amount of light received by the plants, and in the short, dark days of winter the amount of light is very small.

Thus obstructed, transpiration in the forcing houses, through feebleness and short duration of light and an atmosphere more humid than the average in the open during summer months, favors watery tissue, thin cell walls, which are easily stretched, and rapid growth in size. The weakness of the cell walls is increased through lack of sufficient building material, a result of the low degree of assimilation.

During certain processes of destructive metabolism, brought about by respiration, nitrogenous compounds like asparagin, leucin, etc., are built up. When an abundance of carbohydrates are present in the protoplasm the amides are worked up into more complex bodies. When there is a lack of carbohydrates the amides increase and the protoplasm suffers from farther decomposition.

The simultaneous increase of the organic acids tends to overcome the tension of the protoplasm which should hold them in bounds, and they gradually diffuse

through it. This may continue until the protoplasm is killed by the increase and diffusion of these substances.

This study of the environment of the plants under these conditions of forced culture and the operation of the natural forces and physiological processes leads irresistibly to the conclusion that this affection of the tomato plants is a physiological one.

Having reached the conclusion that the disease was due to an excess of root pressure over transpiration, the author took cuttings, and, by means of rubber tubing, cork, and wax, connected them with the station water supply. After subjecting the cuttings for several days to the pressure of the water at 20 to 30 pounds, the same turgidity appeared as is shown in the earlier stages of the disease. A cultural test was also made on four lots of plants subjected to varying conditions. Wherever the conditions approached those of the greenhouse, the cushions were formed. Similar developments have been observed upon various plants by different experimenters, reference to whose work is given.

The author's summary for practical purposes is as follows:

The œdema of the tomato is a swelling of certain parts of the plant brought about by an excess of water which stretches the cell walls, making them very thin and the cells very large. The excess of water may be so great that the cell walls break down, and, that part of the plant dying exerts an injurious influence in adjacent parts.

The excess of water in the tissues is favored by the following conditions:

(1) *Insufficient light.*—The long nights of the early winter months, numerous cloudy days, and in part, the walls and framing of the forcing house deprive the plants of needed light. By a process known as transpiration, plants are relieved of much water when well lighted, but in poor light, since the roots are absorbing water, it is apt to accumulate to excess. Well-lighted parts of the house then should be selected for the tomatoes.

(2) *Too much water in the soil.*—Water in excess can be withheld from the soil to prevent trouble, and yet leave enough for the plants to grow.

(3) *The temperature of the soil may be too near that of the air.*—A high temperature of the soil makes the roots active, and if the temperature of the air is not considerably higher an excess of water is apt to accumulate in the plant. The aim would be then to have the temperature of the air considerably higher than that of the roots.

Lack of proper light also brings about the following harmful conditions:

(1) *Acids in the plant accumulate in the dark and in strong light they decrease.*—When there is an abundance of water in the plant these acids draw large quantities into the cells, causing the cells to swell, resulting many times in œdema, or in the killing of the protoplasm so that these parts of the plant die and become brown or black.

(2) *Lack of light causes weak cell walls.*—It is only when well lighted that plants are capable of making substances to build up cell walls with. Therefore, lack of light not only favors the accumulation of water, if other things are favorable, but it prevents the plants from building up strong tissues. In such cases plants can grow themselves to death. Possibly artificial light might be used to advantage.

A quiet and close atmosphere also favors the accumulation of water in the plant. Good ventilation should then be secured. Some means for the artificial agitation or exchange of the air at night might probably be profitably devised.

Varieties of tomatoes most subject to the œdema.—Those with a tendency to a very rapid and succulent growth are more liable to the trouble. Tomatoes which develop a firm, woody young stem are less liable to it.

Prevention of oat and corn smut, L. H. PAMMEL and F. C. STEWART (*Iowa Sta. Bul. No. 20, Feb., 1893, pp. 721–728*).—Field experiments were conducted on six plats for the prevention of oat smut. Plat 1 was sown with seed previously soaked for two hours in a solution of ferrous sulphate, plat 2 with seed soaked two hours in ammoniacal carbonate of copper, plat 3 with seed soaked two hours in Bordeaux mixture, plat 4 with seed soaked two hours in a solution of corrosive sublimate, plat 5 with seed treated ten minutes with water at 140° F., and plat 6 was the check. The germination on plats 2 and 4 was poor; on the others it was good. So far as the prevention of smut was concerned, the treatment of the seed with ammoniacal carbonate of copper, corrosive sublimate, and hot water was very advantageous.

Tests somewhat similar were conducted in the garden with ten rows of treated oats. The results were favorable to the treatment in most cases. In one case, where the seed was soaked for 24 hours in ammoniacal carbonate of copper, it failed to germinate.

Seed corn was treated before planting with ammoniacal carbonate of copper, corrosive sublimate, Bordeaux mixture, eau celeste, modified eau celeste, hot water, and ferrous sulphate, with no beneficial effect in reducing the amount of smut. A record was kept of the part of the plant on which the smut appeared, which showed that the second, third, fourth, and fifth nodes were the parts of the stalk most often affected.

Oat smut, L. R. JONES (*Vermont Sta. Bul. No. 32, pp. 3*).—A popular account of oat smut, and a report upon the work of the past season in ascertaining the loss in that State and how to prevent it. The loss amounts to about $1\frac{1}{2}$ per cent of the crop. The hot-water method of treating seed is advised not only for the immediate benefit but for the eradication of smut from future crops.

Experiments in the treatment of spot diseases of the cherry and currant and potato blight, L. H. PAMMEL (*Iowa Sta. Bul. No. 20, Feb., 1893, pp. 716–720*).—Bordeaux mixture by the following formula was used for the cherry-spot disease (*Cylindrosporium padi*): Copper sulphate, 6 pounds; lime, 4 pounds; water, 45 gallons. The trees were given four sprayings. There was a decided difference in favor ot the treated trees in the amount of spotting. There was also little powdery mildew (*Podosphæra oxyacantha*) on the sprayed leaves, while the checks were badly affected. Seedling cherries were treated with five sprayings of Bordeaux mixture, with a decided advantage in favor of the treated plants.

Currants were given preventive treatment against *Septoria ribis* and *Cercospora angulata*. Ammoniacal carbonate of copper, Bordeaux mixtures and sulpho-steatite were the fungicides used. Six applications were given the plants, except that in one case seven applications of ammoniacal carbonate of copper were given, and the sulpho-steatite was applied eight times.

Bordeaux mixture was employed to prevent attacks of *Macrosporium*. Considerable blight was noticed before any applications were made, but

the sprayed vines remained green much longer and gave a greater yield of large potatoes than the check. The author failed to find *Phytophthora infestans* in any specimens examined, but the *Macrosporium* was always present. The early and repeated use of Bordeaux mixture is advised for all diseases of potatoes.

The fungus diseases of sugar beets, C. E. BESSEY (*Nebraska Sta. Bul. No. 27, Mar., 1893, pp. 27-29*).—During the summer of 1892 the author's attention was directed to a peculiar root rot of sugar beets. The roots decayed quickly into a moldy, bad-smelling mass. Before the study was completed the material gave out. Should the rot occur this season it will be studied again.

The leaf spot (*Cercospora beticola*) is popularly described. Copper carbonate solution was tried as a preventive remedy, with negative results. From extracts of correspondence with station botanists, the leaf spot is shown to be a widely scattered but not seriously destructive disease of sugar and garden beets.

Report of the botanist, F. L. HARVEY (*Maine Sta. Report for 1892, pp. 99-117, plate 1, figs. 2*).—A general statement is given of the botanical work done during the past season. Correspondence relating to habits and means for repression is given for two weeds, fall dandelion (*Leontodon autumnale*) and golden hawkweed (*Hieracium aurantiacum*).

Reports are given on the following fungi: Leaf blight of pear (*Entomosporium maculatum*), black or hair mold (*Phycomyces nitens*), anthracnose of raspberry and blackberry (*Glœosporium venetum*), and potato blight (*Phytophthora infestans*).

For the leaf blight of the pear spraying with ammoniacal carbonate of copper is advised, and reports of successful tests of the fungicide are given.

The anthracnose of the raspberry and blackberry is fully described and the following precautions are urged: Use care in selecting stock, rejecting all that is in any way affected; remove and burn all dead canes at the close of the season; plant far enough apart to insure plenty of light and air, and train the canes with the same factors in view; spray before buds begin to swell with a solution of copperas, 2 pounds in 5 gallons of water; if the disease appears, spray with Bordeaux mixture.

Tests were made to determine whether the potato-blight fungus was carried over winter in the soil. The results obtained, while not very conclusive, seem to indicate that it does not survive the winter in the soil. A report is given of the use of Bordeaux mixture for the prevention of potato rot, and its more general use is strongly urged.

Report of the bacteriological and microscopical department, H. H. LAMSON (*New Hampshire Report for 1890 and 1891, pp. 216-241, figs. 7*).—The study of the fermentations of silage has been begun and experiments made upon taking the temperature of silage by means of an electrical apparatus.

Experiments were conducted upon pear and apple trees to prevent the pear scab (*Fusicladium pyrinum*) and apple scab (*F. dendriticum*).

Five sprayings were made with either Bordeaux mixture or ammoniacal solution of copper carbonate. The reduced amount of cracked and scabby fruit demonstrated the value of the applications. Bordeaux mixture was also used with good results against potato blight (*Phytophthora infestans*).

Fungus diseases of plants (pp. 221–241).—The author gives a popular description of fungi and their relation to their hosts, two formulas for fungicides, and descriptions and illustrations of spraying apparatus.

The life histories of the following species are given, with suggestions regarding preventive treatment: Potato blight (*Phytophthora infestans*), black rot of grape (*Læstadia bidwellii*), downy mildew of grape (*Peronospora viticola*), anthracnose of grape (*Sphaceloma ampelinum*), apple scab (*Fusicladium dendriticum*), pear scab (*F. pyrinum*), and black knot of cherry and plum (*Plowrightia morbosa*).

Miscellaneous botanical work, W. A. BUCKHOUT (*Pennsylvania Sta. Report for 1892, pp. 179–186*).—*Treatment of corn to prevent smut* (pp. 179, 180).—Seed corn was treated before planting, with hot water, 135° F., for five minutes. A second lot was soaked in water and rolled in smut until covered, and a third lot was planted dry. At the time of cutting, September 4, there was no perceptible decrease in the treated over the untreated seed. The corn came up no quicker, reached no better development, and was attacked by smut to a greater degree than some that was untreated.

Treatment of potatoes to prevent rot (pp. 180, 181).—One lot of tubers was heated at 110° F. for five hours, and another lot was treated for twenty-four hours in copper sulphate (6 ounces in water sufficient to cover a bushel). The first lot grew well, but was affected as badly as the untreated ones. The seed of the other lot was almost entirely destroyed. The question of early digging where the crop is known to be affected, and storing in dry cellars, was investigated, but the results were very indefinite.

Gall mites (pp. 181–184).—The author examined a number of plants to ascertain the cause of their sickly condition. In the majority of cases it was due to the presence of mites, *Phytopti*. A list is given of thirty-eight trees having either galls, erineum, or both.

Root tubercles (p. 184).—The author concludes that tubercles can be grown in water cultures by inoculations or by adding compost to the water.

Germination of tree seeds (pp. 184, 185).—A lot of tree seeds were tested for germination, with the following result:

Kind of seed.	Per cent sprouted.	Kind of seed.	Per cent sprouted.
Pinus insignis	54	*Chamæcyparis lawsoniana*	22
Pinus monticola	13	*Libocedrus decurrens*	29
Pinus ponderosa	37	*Picea mariana*	27
Pinus strobus	54	*Taxodium distichum*	0
Pinus strobus (two years old)	58	*Gymnocladus canadensis*	0
Pseudotsuga taxifolia	38	*Fraxinus americana*	0
Thuya gigantea	4	*Fraxinus viridis*	0

Other experiments gave results quite different from the above for the species of ash.

Miscellaneous (pp. 184, 185).—An examination of *Primula obconica* was made to determine the cause of its attributed poisonous properties, but all the evidence was of a negative character.

The Canada thistle is becoming thoroughly established in various parts of the State. *Puccinia suaveolens* is found abundant upon it, through its attacks greatly weakening the growth, and preventing many plants from seeding. *Cystopus spinulosus* has not been observed at the station as parasitic on this weed, although abundant elsewhere.

The cedar apple (*Gymnosporangium macropus*) did not appear for fully a month later than usual, showing the importance of continuing spraying at least well into June, for the prevention of apple rust.

ENTOMOLOGY.

Grass leaf hoppers, H. OSBORN (*Iowa Sta. Bul. No. 20, Feb., 1893, pp. 713–715, fig. 1*).—A report upon the continued investigation of the life history of these insects. It had been thought that the adults hibernated, but this is true only of *Agallia sanguineolenta* and *Tettigonia hieroglyphica*, the first a clover insect, the other occurring mostly in wooded places. No hibernating specimens of the more destructive genera *Deltocephalus* and *Diedrocephala* were found. The author gives the life history of the following species: *Deltocephalus inimicus*, *D. debilis*, and *Diedrocephala mollipes*. He has found that their eggs are laid just under the epidermis of grass leaves and remain there until spring, the first broods hatching out about the first of May. The last of the above species lays its eggs within the lower leaf sheaths of grasses in low ground, hatching the first brood in the following May. Burning the dead grass late in autumn is advised as a preventive measure.

Some insect enemies of sugar beets, L. BRUNER (*Nebraska Sta. Bul. No. 27, Mar., 1893, pp. 30–33*).—Brief descriptions of *Hadronema militaris*, leaf hoppers, white grubs, and webworms, *Loxostege sticticalis*. The last mentioned is the chief insect pest of the beet. Experiments have been tried with arsenites and kerosene emulsion, with good results. A number of parasites have been reared from worms taken in the laboratory, and doubtless these serve to keep them in check. The life history of the worm is imperfectly known and will be a subject of further study.

Machinery and methods for spraying, H. OSBORN and L. H. PAMMEL (*Iowa Sta. Bul. No. 20, Feb., 1893, pp. 706–712*).—Information is given concerning various forms of spraying apparatus and where they may be obtained. Formulas and directions for use are given for the following insecticides and fungicides: London purple, Paris green, kerosene emulsion, hellebore, pyrethrum, Bordeaux mixture, Bordeaux mixture with arsenites, ammoniacal carbonate of copper, and modified eau celeste.

A provisional calendar is given of the time for spraying against the attacks of insect and fungus enemies.

Some insect pests of the farm and garden, J. M. STEDMAN (*Alabama College Sta. Bul. No. 45, June, 1893, pp. 36, plate 1, figs. 25*).—A popular bulletin on the life history of insects, preparation and use of insecticides, spraying apparatus, and some of the more common and destructive insects. The list of insecticides includes Paris green, London purple, hellebore, white arsenic, pyrethrum, kerosene emulsion, carbolic acid emulsion, tobacco decoction, and bisulphide of carbon. Special mechanical devices for trapping and destroying insects are also given. Illustrations, descriptions, and specific remedies are given for the Colorado potato beetle, cabbage butterfly, cabbage worms, harlequin cabbage bug, cabbage and corn cutworms, cotton leaf worm, bollworm, aphides or cotton lice, and corn worm or bollworm.

Report of the entomologist, F. L. HARVEY (*Maine Sta. Report for 1892, pp. 117-146, plates 2, figs. 4*).—A report is given on the following insects: Fall canker worm (*Anisopteryx pometaria*), the boll or corn worm (*Heliothis armigera*), chinch bug (*Blissus leucopterus*), horn fly (*Hæmatobia serrata*), two-spotted mite (*Tetranychus 2-maculatus*), and cutworms.

The fall canker worm is becoming very troublesome throughout the State. The use of tin bands, which are figured and described, to prevent the wingless females from crawling up the trees, and of arsenites where they have already deposited their eggs, is advised.

The boll or corn worm is figured and described and some suggestions given for probable prevention.

The chinch bug is reported as having caused considerable local damage during the past season. It is figured and described and various remedies suggested to prevent its ravages.

Figures and descriptions of the horn fly are given. Grease, or oil, alone or in combination with carbolic acid or sulphur, may be used as protective remedies. Kerosene, pyrethrum, or tobacco dust will destroy the flies.

The two-spotted mite is described and figured as a new species under the name *Tetranychus 2-maculatus*. It was first noticed on some rose bushes early in 1891, and has since spread throughout quite an ex. tended region. Published correspondence shows it prevalent in numerous widely separated localities. So far it seems to be confined to greenhouses, and 43 host plants are enumerated, which the author thinks is probably an incomplete list. At present there is no entirely effective remedy known. Fir tree oil, diluted about one hundred times with water, alcoholic tincture of pyrethrum, and Cole's insect destroyer are all recommended as sprays of considerable value for this insect.

Report of the entomologist, C. M. WEED (*New Hampshire Sta. Report for 1890 and 1891, pp. 242–263, plate 1, figs. 6*).—A statement is given of the condition of economic entomological work within the State.

Various forms of spraying devices are described and methods of use given; and a refutation is made of the charges that spraying is dangerous. The following insecticides are fully described, and their formulas and method of application given: Paris green, London purple, hellebore, pyrethrum, kerosene emulsion, Cook's soft-soap emulsion, Cook's hard-soap emulsion, and tobacco decoction. The following insects are described and most of them figured: Grasshoppers (*Caloptenus atlanis* and *C. femur-rubrum*), codling moth or apple worm (*Carpocapsa pomonella*), apple maggot or railroad worm (*Trypeta pomonella*), apple-tree tent caterpillar (*Clisiocampa americana*), imported elm-leaf beetle (*Galeruca xanthomelæna*), horn fly (*Hæmatobia serrata*), and woolly alder aphis (*Pemphigus tessellata*). Their life histories are given and remedies suggested for their repression.

FOODS—ANIMAL PRODUCTION.

E. W. ALLEN, *Editor.*

Chemical analyses of some native North Carolina grasses, forage plants, grains, seeds, and by-products, B. W. KILGORE (*North Carolina Sta. Bul. No. 90b., April, 1893, pp. 14*).—Analyses with reference to food ingredients are given of the following materials: Yellow pigeon grass, gama grass, Rhode Island bent grass, knee grass, broad-leafed panic grass, two-edged panic grass, creeping panic grass, wild panicum, *Panicum microcarpon*, barnyard grass, false redtop, switch grass, bitter grass, American canary grass, awned bunch grass, sea grass, broad-leafed grass, false fescue, wild rice grass, swamp cane, cord grass, marsh cord grass, horned sedge, twisted beard grass, beard grass, pickerel weed, sedge, false redtop, false rice, broom sedge, yard goose grass, bull grass, marsh grass hay, Italian rye grass, fowl meadow grass, Johnson grass, orchard grass, Kaffir corn, Kaffir corn flour, Kaffir corn midlings, white millo maize, yellow millo maize, durra, broom corn, sorghum, German millet, pearl millet, Hungarian millet, silage corn, corn stalks, corn leaves, corn silage, corn meal, hominy mill feed, whole corn, oat meal, wheat bran, alfalfa, cowpea-vine hay, crimson-clover hay, red-clover hay, mammoth clover, soja-bean hay, soja-bean silage, bush clover, peanut vines and leaves, peanut hulls, peanut kernels, whole raw cotton seed, whole roasted cotton seed, meal from roasted cotton seed, cotton (stalks, burs and leaves), whole cotton seed, rice straw, rice chaff, rice grain, rice flour or meal, rice polish, buckwheat, barley, okra pods, okra seed, hulls of sunflower seed, and kernels of sunflower seed. The analyses are accompanied by a descriptive text.

The native grasses were most of them collected when ripe or nearly ripe. The composition of some of those which from these analyses seem most promising, together with that of the okra and sunflower seed, are given in the following table:

Analysis of native North Carolina grasses, forage plants, etc.

	Water.	In 100 parts of dry matter.				
		Crude protein.	Crude fat.	Nitrogen-free extract.	Crude fiber.	Ash.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Gama grass (*Tripsacum dactyloides*)	7.63	9.88	1.88	47.81	33.27	7.16
Knee grass (*Panicum proliferum*)	8.73	14.79	3.57	45.49	27.74	8.41
Wild panicum (*Panicum verrucosum*)	5.74	9.08	2.75	47.59	32.94	7.64
Panicum microcarpon	9.81	8.10	2.86	49.64	31.98	7.42
False red top (*Panicum agrostoides*)	8.46	8.19	1.71	41.72	36.19	12.19
Switch grass (*Panicum virgatum*)	8.02	8.09	1.61	47.78	36.37	6.15
Bitter grass (*Panicum amarum*)	7.52	11.22	2.11	45.23	32.07	9.37
Broad-leafed false fescue (*Uniola latifolia*)	6.75	9.71	2.91	41.85	37.00	8.53
Swamp cane (*Arundinaria macrosperma*)	8.53	12.36	4.48	33.53	38.26	11.37
Pickerel weed (*Pontederia cordata*)	10.55	15.72	3.16	39.38	27.73	14.01
False rice (*Leersia virginica*)	5.02	9.21	2.58	43.67	33.33	11.21
Yard goose grass (*Eleusine ægyptiacum*)	5.01	13.42	2.31	37.63	35.53	11.11
Okra pods	6.00	5.05	0.84	34.97	50.63	8.51
Okra seed	7.06	22.86	16.26	26.28	28.35	6.25
Sunflower-seed hulls (Mammoth Russian)	10.00	4.17	1.73	30.58	60.96	2.56
Sunflower-seed hulls (Black Giant)	10.50	4.88	3.81	24.69	63.69	2.93
Sunflower-seed kernels (Mammoth Russian)	6.90	31.54	47.17	13.98	2.84	4.47
Sunflower-seed kernels (Black Giant)	6.85	33.89	44.82	17.11	2.68	1.50

Okra seed is rich in protein and fats, while the hulls are low in their content of these substances. The proportion of hulls and kernels in the samples separated by hand for analysis were, pods, 59.5 per cent; kernels, 40.5 per cent * * * .

The sunflower has been grown in Russia for a great many years, and since 1842 on a commercial scale. There are two kinds grown there—one with small seeds used for the production of oil, which has "superseded all other vegetable oils in many parts of Russia, and the other with large seeds, consumed by the common people in enormous quantities as a dainty." The cultivation is considered profitable there, the average yield being about 1,350 pounds per acre. The oil from the sunflower-seed is obtained in Russia very much as cotton-seed oil is in the United States, by separating the hulls from the kernels and expressing the oil from the latter. The sunflower-seed cake is a highly nitrogenous cattle food, and is largely exported to Germany and England for feeding purposes; the hulls, or shells, of the seed are used as fuel, while the seed-cups are fed to sheep * * * .

The analyses show the hulls of both varieties of sunflower seed to contain more protein, fats, and crude fiber, and less nitrogen-free extract than cotton-seed hulls, andin dicate that they are at least equal, if not superior, to cotton-seed hulls as a cattle food; while the kernels contain more oil than the kernels of cotton seed, and together with the other nutrients show that, after the oil is expressed, the sunflower cake left will be fully up to, if not better, than cotton-seed cake as a food stuff.

Percentage of parts of	Cotton seed	Hulls, 50 per cent. Kernels, 50 per cent.
	Mammoth Russian sunflower seed	Shells, 52.9 per cent. Kernels, 47.1 per cent.
	Black Giant sunflower seed	Shells, 54.5 per cent. Kernels, 45.5 per cent.

The percentages of parts of the two varieties of sunflower seed were obtained by the separation of the seeds analyzed, and are subject to change with further investigation. These percentages with the chemical compositions of the parts presented in the table show that whole cotton seed and whole sunflower seed do not differ materially in composition.

Sunflower seeds were sent out to quite a number of coöperative field experimenters by the station last season, but results of yields are not yet in shape for publication. The average yield in five experiments in as many parts of the State in 1889 was about 65 bushels per acre.

The results of weighing one lot each of Mammoth Russian and Black Giant sunflower seed at this station gave 26.7 pounds per bushel for the former and 32 for the latter. The Mammoth Russian seed, according to our analyses, contains 21.53 per cent of oil and the Black Giant 20.85 per cent. One bushel of the former would therefore contain 5.75 pounds of oil, and the latter 6.67 pounds of oil.

Miscellaneous fodder analyses (*Massachusetts State Sta. Bul. No. 47, May, 1893, pp. 13–16*).—Analyses of corn meal, gluten feed, skim milk, artichokes, mangel-wurzels, carrots, gluten meal, excelsior feed, wheat bran, "proteina," rye feed, and glucose refuse with reference to fat and usual fertilizing ingredients.

Patent cattle foods (*New Hampshire Sta. Report for 1890 and 1891, pp. 211–215*).—A reprint of Bulletin No. 15 of the station (E. S. R., vol. III, p. 877).

Sampling corn fodder, H. P. ARMSBY (*Pennsylvania Sta. Report for 1891, pp. 32, 33*).—To test different methods of sampling corn for analysis the following experiment was made:

Four rows of silage corn, covering 14 by 100 feet were selected where the corn appeared fairly uniform, and were sampled in three different ways.

(1) Two samples of twenty average plants were selected from the standing corn. Each of these samples was passed through a fodder-cutter, a subsample of 10 to 15 pounds was taken from the cut material after thorough mixing; this sample was chopped fine in a large meat-chopping machine, and a final sample of about 1 kilo taken for analysis. All this was done separately with the two lots of plants.

(2) The remainder of the corn was harvested as usual and run through the fodder-cutter and crusher. The cut material having been thoroughly mixed, two samples of about two kilos each were taken and used directly as analysis samples.

(3) Two larger samples of 10 to 15 pounds each were taken from the same cut material. Each of these was passed separately through the meat-chopper, and about 1 kilo of the finely chopped fodder taken for an analysis sample.

The results of the six analyses, as tabulated, indicate that any one of the three methods may be safely used.

Methods of sampling (*Pennsylvania Sta. Report for 1891, pp. 210–212*).—General directions for sampling feeding stuffs, dairy products, and seeds.

The composition and digestibility of the different parts of corn fodder, H. J. PATTERSON (*Maryland Sta. Bul. No. 20, Mar., 1893, pp. 16*).

Synopsis.—Determination of the digestibility of different parts of the corn plant with two two-year-old steers. From these figures and other data obtained at the station the amounts of digestible food ingredients contained in different parts of the corn plant are calculated and compared with the amounts in 2 tons of clover and timothy hay. The stubble and husks were found to contain 60 per cent of the total digestible matter, and the blades only 11 per cent. The corn stover from 1 acre contained more digestible matter than the ears from 1 acre and as much as 2 tons of timothy hay.

Determinations were made of the coefficients of digestibility of corn stubble or butts, topped fodder (stover), corn husks, and blades of pulled fodder, using two grade steers about two years old. Each fodder was fed in a period by itself, and it would appear that no other

food was fed. Six pounds of material per head and per day was fed in each case. The excreta were collected during the last five days of each period. These data, together with analyses of the different parts of the corn plant are tabulated. The following is a summary of the results:

Digestibility of different parts of the corn plant.

	Dry matter.	Crude ash.	Crude protein.	Crude fiber.	Crude fat.	Nitrogen-free extract.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Corn butts or stubble:						
Steer A	69	11	27	75	80	73
Steer B	64	12	15	71	79	65
Average	66.5	11.5	21	73.5	79.5	69
Topped corn fodder:						
Steer A	52	7	17	69	65	50
Steer B	58	8	27	72	62	57
Average	55	7.5	22	70.5	63.5	53.5
Corn husks:						
Steer A	73	24	35	81	42	75
Steer B	71	8	24	78	23	75
Average	72	16	29.5	79.5	32.5	75
Corn blades (pulled fodder):						
Steer A	62	33	28	75	52	66
Steer B	67	45	41	80	59	70
Average	64.5	39	34.5	77.5	55.5	68

Using these figures and the average yields at the station of different parts of the corn plant for three years, a calculation is made of the yield per acre of digestible matter in various parts of the corn plant.

Yield per acre of digestible matter of different parts of the corn plant.

	Ears.	Topped fodder.	Blades.	Husks.	Stubble.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Total dry substance	1,530	450	197	426	569
Ash	....	5	14	4	5
Crude protein	157	10	6	6	6
Crude fiber }	1,343	190	88	168	241
Nitrogen-free extract }	....	232	105	246	304
Fat	30	13	4	2	13

	Pounds.
Total digestible matter in ears	1,530
Total digestible matter in fodder	1,642
Total digestible matter in entire corn crop	3,172

The above figures are compared with those for a crop of 2 tons of clover and of 2 tons of timothy hay.

[According to these figures] an ordinary corn crop produces more dry matter and more digestible matter than a good crop of either clover or timothy hay. In fact the digestible matter in the fodder alone about equals the digestible matter in 2 tons of either clover or timothy hay.

Coming to the question of the distribution of the digestible matter in the different parts of the fodder (stover), we find that three-fifths of the digestible matter is contained in the stubble and husks, parts which are almost entirely wasted; and that the blades, which alone receive any economical treatment in preservation and feeding, contain but one-ninth of the digestible substance existing in the corn plant. Surely the farmer who appreciates the enormity of these figures and the

great loss of food annally taking place on the farms, will immediately take some steps towards the economical saving and feeding of these parts which are now going to waste.

Again when we consider that the corn fodder (stover) from 1 acre contains as much digestible matter as the corn ears from 1 acre, we can no longer regard corn fodder (stover) as a worthless material and treat it with so much disregard, but we must realize the fact that it is worthy of careful consideration and intelligent care, both in saving it and in securing its complete consumption by cattle. * * *

There is enough digestible matter produced by the corn fodder grown in the Southern States to winter all the live stock existing in those States, if it was properly preserved and prepared in a palatable form. * * *

By cutting and crushing the corn stalks, cattle will eat and utilize nearly all of them.

Determination of the digestibility of rations, F. W. MORSE (*New Hampshire Sta. Report for 1890 and 1891, pp. 177–181*).—A reprint from Bulletin No. 11 of the station (E. S. R., vol. II, p. 414).

The economical rearing of calves, T. F. HUNT and C. H. ZINK, JR. (*Pennsylvania Sta. Report for 1891, pp. 112–117*).

Synopsis.—As between whole milk, skim milk, and skim milk mixed with linseed-meal porridge for young calves, the trial indicates whole milk to be superior in nutritive effect, although the gain on it was more expensive, pound for pound, than on skim milk. There appeared to be no advantage from adding the linseed-meal porridge.

An account is given of an experiment made to compare whole milk and skim milk with each other and with skim milk to which linseed-meal porridge was added. The trial included 9 calves, ranging from one to three months old, divided into three equal lots. Lot 1 received 17 pounds each of whole milk; lot 2, 16 pounds each of skim milk and 1 pound of steam-cooked linseed meal stirred up with hot water; and lot 3 received 17 pounds of skim milk. Each lot received in addition hay and all it would eat of equal parts of shelled corn and oats. The whole milk contained about 4.5 per cent of fat, and the skim milk, as a rule, less than 0.1 per cent.

The trial lasted from June 1 to November 8, one hundred and sixty-one days. The results were as follows:

Gain, food eaten, and cost of gain for calves.

	Lot I.	Lot II.	Lot III.
Daily gain per animal .... pounds..	1.77	1.11	1.35
Daily gain per 1,000 pounds live weight .... do....	6.53	4.76	5.92
Dry substance eaten daily per animal .... do....	4.40	5.40	4.90
Dry substance eaten daily per 1,000 live weight .... do....	16.30	23.20	21.50
Dry substance required to produce one pound increase .... do....	2.50	4.90	3.60
Cost of food per pound of increase .... cents..	9.90	4.70	3.40

The estimated cost of food is based on shelled corn at 39.3 cents, and oats at 30.9 cents per bushel; hay at \$9.34 per ton; whole milk at \$1, and skim milk at 12 cents per 100 pounds

The calves fed on whole milk made the largest gain per day and ate the least quantity of dry substance, making 1 pound of increase for each 2½ pounds of dry

substance eaten, while the lot fed on plain skim milk made a pound of increase for each 3.6 pounds of dry substance eaten. The calves fed linseed meal and skim milk made the least gain per day and ate the largest quantity of dry substance, requiring nearly twice as much dry substance for each pound of gain as the calves fed whole milk. * * *

The ordinary observer would distinguish at once the superior condition and appearance of the calves fed on whole milk, and also that of those fed on plain skim milk as compared with those fed on linseed meal and skim milk. * * *

The superior nutritive value of a pound of dry substance in whole milk is amply illustrated. This is, probably, due to the fat of the whole milk, which constitutes about one-third of its total dry substance. The greater cost of the whole milk makes the cost of a pound of increase much greater, being 9.9 cents as compared with 3.4 cents in the plain skim-milk calves.

Steer feeding, J. WILSON and C. F. CURTISS (*Iowa Sta. Bul. No.* 20, *Feb., 1893, pp. 639–689*).

Synopsis.—An experiment with eighteen steers of nine different breeds to compare linseed meal with corn meal for growing and for finishing steers. The trial was with two-year-old steers and lasted nine months. The results, as shown by the average gains and the cost of the same, were rather favorable to the corn meal for growth and to the ration containing a large proportion of linseed meal for finishing, although the results were not very decisive. The slaughter test showed the dairy breeds to be somewhat lacking in desirability. There was a profit of about $206 from feeding the eighteen steers.

The objects of this experiment were to compare linseed meal with corn meal for steers on grass and to compare finishing them with an increasing carbonaceous ration and with an increasing nitrogenous ration. For this purpose eighteen grade steers were used, two each of the following breeds: Shorthorn, Red Poll, Hereford, Holstein, Galloway, Angus, Swiss, Devon, and Jersey. The steers were nearly two years old when the trial commenced. They were purchased in July, 1891, at an average price of $3.25 per hundredweight. The feeding trial commenced March 1, 1892, and lasted until December 31. This time was divided into three periods of ninety-two days each. In the first period, March 1 to May 31, the animals were fed in the barn. The food consisted of corn meal, linseed meal, hay, sugar beets, and corn fodder. The second period lasted from June 15 to September 15. During this time the steers were fed in two separate lots, each lot containing one steer of each of the breeds. They were pastured in luxuriant clover pastures, equal in size and grazing capacity. In addition to the pasturage, lot 1 received corn meal at the rate of about 12 pounds per head daily, and lot 2 received linseed meal at the rate of about 8 pounds per head daily. From September 15 to October 1, the cattle were gradually changed from pasturage to dry yard feeding. The plan was to change lot 1 from pasturage and corn meal to a nitrogenous grain ration, consisting of corn and an increasing amount of linseed meal; and to change lot 2 from pasturage and linseed meal to a more carbonaceous ration, consisting of corn and a decreasing amount of linseed meal. The third period commenced October 1 and con-

tinued until December 31. The coarse fodder, hay, green-corn fodder, or stover, "snapped" corn, and mangels, were the same for both lots. The following table summarizes the result for each lot in each period:

Total and average results of steer feeding.

	Average weight at beginning of period.	Nutritive ratio of food.	Total gain in live weight.	Average daily gain per steer.	Total cost of food.	Average cost of food per pound of gain.
	Pounds.		*Pounds.*	*Pounds.*		*Cents.*
Period I, all fed alike	868	1:9.4	4,116⅓	2.48	$244.08	5.93
Period II:						
Lot 1, corn meal	1,113	1:5.8	1,924	2.32	82.97	4.31
Lot 2, linseed meal	1,113	1:2.6	1,679	2.03	105.35	6.21
Period III:						
Lot 1, increasing nitrogenous ration	1,341	1:9.5	2,701	3.26	160.03	5.92
Lot 2, increasing carbonaceous raiion	1,309	1:9.9	2,320	2.80	148.03	6.38

The total cost of food and cost of food per pound of gain are based on the following prices for feeding stuffs: Corn meal $12, linseed meal $15, hay and corn fodder $3, corn stover $1.20, sugar beets 60 cents per ton, and pasturage $3 per acre. No account was taken of the value of the manure produced.

At the conclusion of the experiment the steers were all shipped to Chicago, where they were slaughtered. They were sold at the stock yards for 6 cents per pound of live weight, which "was 50 cents per hundred weight more than any other of 15,000 cattle on sale sold for on that day." The following statement shows the financial result of the feeding:

Cost of 18 steers, 15,651⅝ pounds, at $3.50 per cwt., March 1	$547.82
Cost of food during nine months under experiment	740.46
Cost of food thirty days during two changing periods	60.00
Freight, yardage, food, and commission	96.87
Total cost, except labor	1,445.15
Received for 18 steers, 27,530 pounds, at $6 per cwt	1,651.80
Balance	206.65

There were unusual expenses that reduced the profits. We had unnecessary freight expenses, on account of car room. The expense of feeding during the changing periods was over 14 cents a pound, and the feeding of lot 2 in the last two periods was unduly expensive. Lot 2 was not fed economically, as the experiment proves.

The steers were slaughtered by Swift & Co., of Chicago, January 5. A careful record was made of the data for each steer showing shrinkage in dressing, the weight of the internal organs, content of stomach, blood, hide, etc., and of the several cuts of meat. These data are fully tabulated and are summarized for the eighteen steers. The following table shows for each breed the estimated selling price, the total gain made in nine months, and the percentage of dressed beef:

Results of steer-feeding experiment.

	Number.	Gains for nine months.	Estimated selling value.	Dressed meat.
		Pounds.		*Per cent.*
Shorthorn	1	718⅓	$6.37½	64.3
	2	799	6.37½	67.2
Red Poll	3	643⅔	6.25	66.5
	4	660⅔	6.25	63.8
Hereford	5	740	6.62½	67.4
	6	694	6.62½	66.6
Holstein	7	629⅓	5.00	60.6
	8	709⅔	5 00	61.6
Galloway	9	833⅔	6.37½	66.4
	10	663⅓	6.37½	66.7
Angus	11	833⅓	6.37½	67.1
	12	706⅔	6.37½	64.6
Swiss	13	781⅔	6.00	64.8
	14	678⅓	6.00	64.8
Devon	15	706	5.75	62.5
	16	653⅓	5.75	63.8
Jersey	17	717⅔	4.50	63.9
	18	573⅓	4.50	58.7

The carcasses of the dairy breeds lacked in thickness of cuts, and the marbling of fat and lean was not equal to that of the others. The cuts from the several beef breeds were of about equal quality, but the leading hotels, in contracting for their meat supplies, specify very fully the maximum and minimum size and weight of all cuts; and the reason the estimated value on foot of the Red Polls and Devons fell below the other beef breeds was that one of the Polls and both of the Devons were a little under size, and had the rib and loin cuts from these and the Jerseys and Holsteins been sold separately, they would have brought somewhat less than the prime cuts of standard size, although the Devons and Polls were of very fine quality. The cutter said he never cut better beef than one of the Red Poll carcasses.

Sheltered vs. unsheltered stock (*Utah Sta. Report for 1892, pp. 21–29*).—Trials are reported with steers, sheep, and pigs, made during an average winter. There were three lots of three steers each, one lot being fed in the open air, clear of the barn; another lot fed in the barn in box stalls 6 by 9 feet, and a third lot fed in the barn, tied by chains.

The trials with sheep included two lots of three animals each, one lot being fed in the barn and the other in the open air.

The pigs, two lots of three each, were fed either in a hog house or in a pen outside the hog house.

The following is the author's summary of his conclusions:

(1) Cattle, sheep, and swine on the whole required more food to maintain existence when fed in the open air than when housed.

(2) Cattle and hogs made a more economic gain in the open air than when housed.

(3) Sheep in the barn did better in every respect than in the open air, although confined in very small pens.

(4) Cattle in box stalls did better than those tied up.

(5) The greater the freedom of motion up to the freedom of a yard some 10 rods square, the more food eaten and the less required for a pound of gain for cattle.

(6) The trial indicates that free access to shelter and yards is more economical than compulsory life in the storms or in close confinement in the barn. This question is under trial, forming the eight years' investigation of this question of shelter of stock.

The feeding and management of cattle, W. A. Henry (*Wyoming Sta. Bul. No. 13, July, 1893, pp. 37–102*).—This is a reprint of a paper

published in the Special Report on Diseases of Cattle and on Cattle Feeding by this Department.

Feeding value of corn meal and bran for the production of butter, T. F. HUNT (*Pennsylvania Sta. Report for 1891, pp. 108–112*).

Synopsis.—A comparison of corn meal with wheat bran, fed in like amounts to two lots of six cows each. The lot on wheat bran refused to eat its full allowance. In point of yield of total milk and butter, and food required per pound of milk, the advantage was with the lot on corn meal.

In this comparison of corn meal and wheat bran, two lots of six cows each, well along in milk, were used. Each lot contained three Guernseys, one Jersey, one Ayrshire, and one grade Shorthorn. In the first period, June 15 to 28, both lots were fed alike, receiving 4 pounds of corn meal and 6 pounds of bran per cow daily. In the second and third periods (July 6 to 26 and July 27 to August 23) lot 1 received 10 pounds of bran each and lot 2, 10 pounds of corn meal. Hay was fed in all three periods, together with green timothy and clover in the first period, green oats in the second, and green corn fodder in the third. At the close of the second period two cows were dropped from each lot, being too far advanced in the milking period.

More corn meal was eaten than wheat bran, as the lot on wheat bran refused to eat the whole ration.

The result during the first two periods was as follows:

Milk and butter fat produced.

	Total milk.	Milk daily per animal.	Butter fat in milk.	Butter fat given per lot.	Butter fat daily per animal.
	Pounds.	*Pounds.*	*Per cent.*	*Pounds.*	*Pounds.*
Period I.					
Lot 1. Corn meal and bran	1,477	17.6	4.30	64	0.76
Lot 2. Corn meal and bran	1,251	14.9	1.15	52	0.62
Period II.					
Lot 1. Bran	1,487	11.8	4.06	60	0.48
Lot 2. Corn meal	1,554	12.3	3.85	60	0.48

When fed alike, lot 1 gave considerably more milk and butter than lot 2 and ate less food per pound of milk, but on corn meal alone lot 2 fully equaled lot 1 on bran alone. Tables are given showing the composition of the milk at frequent intervals.

"From whatever avenue approached, the results indicate that in this experiment the feeding value of the corn meal was about one-fifth greater than that of bian as an exclusive grain diet for the production of butter fat, the grain being 25 to 40 per cent of the total food eaten, and the coarser fodder being timothy hay and green oats or green corn fodder."

The value of cotton-seed meal as compared with bran for the production of butter, T. F. HUNT (*Pennsylvania Sta. Report for*

1891, pp. 92-108).—A reprint of Bulletin No. 17 of the station (E. S. R., vol. III, p. 468).

Rye vs. silage, A. J. BONDURANT and A. F. CORY (*Alabama College Sta. Bul. No. 46, June, 1893, pp. 7*).—A report of a comparison of corn silage with green rye fodder during four weeks, from February 3 to March 2, on four thoroughbred Jersey cows divided into two lots. The feeding was in two periods of two weeks each. During the first period lot 1 received rye and lot 2 silage, and at the end of the first period the lots were reversed. The grain and coarse fodder, corn-and-cob meal, cotton-seed meal, oat straw, and pea hulls were the same for both lots. The cows were fed all the silage or green rye they would eat.

The yield of milk and the amounts of rye and silage eaten are tabulated for each lot. In the case of both lots the yield of milk was somewhat higher (27¼ and 74¼ pounds, respectively) on rye than on silage.

Silage in dairy farming (*New Hampshire Sta. Report for 1890 and 1891, pp. 203–211*).—A reprint of Bulletin No. 14 of the station (E. S. R. vol. III, p. 88.)

Feeding tests with sugar meal, cream-gluten meal, and germ feed, W. W. COOKE (*Vermont Sta. Bul. No. 31, pp. 3*).—This bulletin reports briefly the results of a feeding trial with nine cows to compare cream-gluten meal, corn-germ feed, or corn bran and gluten feed with each other and with a ration of 4 pounds each of bran and corn meal. The trial lasted from February 23 to June 14, 1892. Each of the three foods tested was fed in a four weeks' period. In the intermediate periods the corn meal and bran ration was fed. The coarse fodder consisted of corn silage and cut hay. No data are tabulated. From the results of this single trial "we are led to the conclusion that the germ feed has about the same feeding value as a mixture of equal parts by weight of wheat bran and corn meal; that sugar meal and cream-gluten meal both have a higher feeding value than the above; and that these latter also have a slight effect on the richness of the milk."

Record of the Vermont Station herd for the year 1892, W. W. COOKE (*Vermont Sta. Bul. No. 33, pp. 3*).—This contains in tabulated form a summarized record of the station herd for the year 1892. Some of the best records reported are as follows:

Pipchin Second, 10,746 pounds milk, 405 pounds butter in a year.

Bright Eyes, 6,726 pounds milk, 419 pounds butter in a year, 14.1 pounds butter in 7 days.

Cigarette, 10,691 pounds milk, 431 pounds butter in a year.

Sadie's Delight, 9,004 pounds milk, 454 pounds butter in a year, 14.2 pounds butter in a week.

Myrtle, 7,482 pounds milk, 482 pounds butter in a year.

The highest record we have ever had is that of Dinah, who has given 52 pounds milk in a day and 12,224 pounds milk in a year, while the butter record is 16.4 pounds butter in 7 days, and 506 pounds butter in a year.

That these cows have been liberally fed, goes without saying. The regular grain ration was 8 pounds per day per cow for those in milk. This has been increased for

some of the heaviest milkers and decreased for the younger stock. This grain has been mostly wheat bran and corn meal, equal parts by weight, though it has been varied greatly in the different experiments.

Dorset horn sheep, D. O. NOURSE (*Virginia Sta. Bul. No. 25, Feb., 1893, pp. 12, plate 1, fig. 1*).—This is a paper on the history of Dorset sheep in England and in America, a discussion of their merits, with opinions of sheep-growers in this country, the experience with them at the station, and a list of the lambs, weight and fleece from three ewes on the station farm.

Our own experience, while very limited, has been encouraging. The sheep are easily kept, docile and quiet, nicely shaped, and the best of mothers. We would also add another feature not mentioned in experiences given, yet a fact well known to breeders, they have but little fear of dogs, and often will drive them from the field—the ewe, when caring for her young, showing at times the greatest courage in this direction. Concerning the quality of wool, we sent a small lot to a Richmond commission merchant, and his reply we give in full: "We inclose herewith statement and check for one sack wool. We find that this is a very desirable staple, and good strong wool. There is only one feature of it that detracts from its being specially attractive, and that is, that it has a little too much weight to it. This, of course, is better for the grower, but the manufacturers want it in light condition, so as to produce the greatest amount of goods out of the smallest amount of weight. We believe this grade wool will sell well. If you should have any the coming spring, we shall be glad to handle it for you."

A comparison of pasturage, soiling, and hay for sheep (*Utah Sta. Report for 1892, pp. 14–20*).—Three pieces of land, each three fourths of an acre in size, were used in this trial. From June 1 to July 29, three lots of two sheep each were fed, lot 1 being pastured, lot 2 fed green grass in the barn, and lot 3 fed dried grass in the barn. Each lot was confined to the product of one of the three-fourths-acre plats. By July 29 the grass had ripened and commenced drying up, so that the lots were fed from that time until September 21 in a similar manner on grass and hay from a mixture of varieties which remained green. At the close of the trial the sheep were slaughtered.

The changes in live weight, calculated amounts of food eaten, and data obtained at time of slaughtering are tabulated for each lot. The largest increase in live weight was made by the lot on pasturage, and there was little difference between the gains in weight by the lot on green grass and the lot on hay.

The calculations made of the amount of dry matter eaten by each lot indicate that the lot fed green grass ate less than either of the other lots. "Lot 1 (pasturage) required less pounds of food for a pound of gain than did lot 2 (soiling)." The difference, however, seemed to be but small. The shrinkage at time of slaughtering was practically the same for the three lots.

Feeding experiments with pigs, J. B. LINDSEY (*Massachusetts State Sta. Bul. No. 47, May, 1893, pp. 2–12*).—A description of the eighteenth and nineteenth feeding experiments with pigs at the station. For accounts of earlier experiments see Annual Reports of the station for 1890 and 1891 (E. S. R. vol. III, p. 155; IV, p. 68).

Eighteenth feeding experiment (pp. 2–6).—Six grade Chester White pigs weighing from 25 to 30 pounds each were used in this experiment. They were all fed alike, but in separate pens. The trial lasted from August 9 to November 28. In the first period, when the pigs weighed from 25 to 80 pounds, they received 2 ounces of corn meal to each quart of skim milk fed *ad libitum;* in the second period, 80 to 125 pounds, 4 ounces of corn meal to each quart of skim milk and 4 ounces of gluten meal as a substitute for each quart of skim milk when the supply of skim milk ran short; and in the third period, 125 to 180 pounds, they received 4 to 6 quarts of skim milk and all they would eat of a mixture of 1½ parts of corn meal to each part of gluten feed. The nutritive ratio of the food was 1:3.3 in the first period, 1:4.5 in the second period, and 1:4.9 in the third period. The summary of the average results for the six pigs is given as follows:

Live weight gained during the experiment ....pounds..	155.60
Per cent of loss in dressing....	21.60
Dry matter eaten per pound of gain in live weight....pounds..	2.27
Cost of food per pound of gain in live weight....cents..	3.64
Net cost of food per pound of dressed weight....cents..	3.30
Total profit per pig....	$3.29

The cost of food is based on corn meal at $24 and gluten feed at $23 per ton, and skim milk at 1.8 cents per gallon. The net cost of food takes account of the value of the fertilizing ingredients of the food.

Analyses of the feeding stuffs used with reference to fertilizing ingredients are given.

Nineteenth feeding experiment (pp. 6–12).—This experiment was made to continue the trial with gluten feed and to compare a wide and a narrow ration. Six pigs were divided into two equal lots. Lot 1 was fed in a similar way to the pigs in the preceding experiment, the division into periods being the same; lot 2 was fed 6 ounces of corn meal to each quart of milk in the first period, and in the second and third periods 4 quarts of skim milk, 2 quarts of water, and corn meal *ad libitum*. Lot 2, therefore, received food having a wider nutritive ratio, the ratio for it being 1: 4.2 in the first period (lot 1, 1: 3), 1: 5.3 in the second period (lot 1, 1: 3.6), and 1 : 6.5 in the third period (lot 1, 1: 4.5). The trial lasted one hundred and twenty-six days. The summarized results were as follows:

Summary of results of pig feeding.

	Lot 1 (narrow ration).	Lot 2 (wide ration).
Average live weight gained ....pounds..	146.17	152.00
Per cent of loss in dressing....	18.53	18.10
Dry matter eaten per pound of gain in live weight....pounds..	2.82	2.57
Dry matter eaten per pound of gain in dressed weight....do....	3.45	3.18
Cost of food per pound of live weight....cents..	4.55	3.95
Cost of food per pound of dressed weight....do....	5.58	4.91
Net cost of food per pound of dressed weight ....do....	3.88	3.90
Average profit per pig....	$4.60	$4.95

The net cost of food takes account of the value of the fertilizing ingredients of the food. The pigs were sold at 7¾ cents per pound, live weight. No difference in the amount of intestinal fat was observed in either lot.

Briefly stated, from a practical standpoint, these two experiments and many others made at the station teach us the following lessons:

(1) Skim milk, together with corn meal, gluten meal, wheat bran, gluten feed, maize feed, etc., combined as above stated have proved healthy and profitable foods for the production of pork for our markets.

(2) With skim milk reckoned at 1.8 cents per gallon, gluten feed at $21 to $23 per ton, and corn meal at $23 to $24 per ton, we have been enabled in these experiments to produce dressed pork at from 4.6 cents to 5.3 cents per pound. The net cost of the dressed pork produced (obtained by deducting the value of the manure produced) was from 3.3 to 3.8 cents per pound.

(3) Farmers having a quantity of skim milk at their disposal can utilize it profitably by feeding it to growing pigs, as above described. If this milk can be sold, however, at 1 cent per quart, or more, it would undoubtedly be more profitable to sell it than to use it in the production of pork.

(4) Experiments made at this station have proved that it is not profitable to feed pigs after they reach a weight of 180 to 190 pounds, excepting, perhaps, when pork commands an exceptionally high price. Fed beyond this weight, the food consumed increases, and the percentage of gain in live weight steadily decreases, so that the daily cost of food consumed is more than the value of the daily increase in weight. This fact has since been confirmed by other stations.

(5) In the last experiment, lot 2 (wide ration) gave slightly more favorable results than lot 1 (narrow ration). These results are not decisive enough to enable us to make any deductions, especially when the results of previous experiments at this station with narrow rations and experiments elsewhere with both wide and narrow rations are considered. Repeated trials are necessary to establish facts.

Practical rations for pig feeding (pp. 10, 11).—Three sets of rations are recommended for pigs at different stages of growth. These rations are given as the result of experience at the station in pig feeding.

Feeding experiments with pigs, G. H. WHITCHER (*New Hampshire Sta. Report for 1890 and 1891, pp. 168–176*).—A reprint of Bulletin No. 11 of the station (E. S. R., vol. II, p. 413).

Grass vs. non-grass fed pigs, J. W. SANBORN (*Utah Sta. Bul. No. 22, May, 1893, pp. 1–7*).—The object of this trial was to determine the value of grass in addition to a liberal grain ration for pigs, and to determine the effect of exercise in a large pasture or a yard and confinement in a small pen.

Four lots of three pigs each were fed from May 25 to October 14. Lot 1 received pasturage; lot 2 was confined in a yard 6 by 8 rods, and grass was cut and carried to it; and lots 3 and 4 were confined in pens 8 by 16 feet, one lot receiving grass, and the other no grass. The four lots received all the grain they would eat, composed of ground wheat, ground barley, and bran. The following table summarizes the results by lots, the figures given being the total for the three pigs in each lot:

Gains in weight and food consumed by pigs.

	Gain in weight.	Grain eaten.	Grass eaten.
	Pounds.	*Pounds.*	*Pounds.*
Lot 1, pastured	461	2,285.7	Not det.
Lot 2, green grass in yard	428	2,254.0	531
Lot 3, green grass in pen	329	2,114.0	531
Lot 4, no grass in pen	332	2,114.0	None.

These results show that the lots allowed considerable freedom for exercise gained more in live weight than the two lots kept in pens, but that they also ate slightly more grain. The two lots kept in pens made almost exactly the same gain in live weight and ate the same amount of grain, showing no apparent advantage from feeding grass. "The inference is that exercise to a growing pig is desirable for the purpose of inducing large consumption. The figures show no pronounced advantage in favor of feeding grass to pigs."

Two meals vs. three meals daily (*Utah Sta. Report for 1892, pp. 36–39*).—Three trials were made with pigs and steers, two lots of three each. The food of the pigs was oats, peas, barley, and wheat, fed ground; and of the steers alfalfa, wild hay, roots, and grain, the character of which is not stated. The results are summarized as follows:

(1) Shoats fed twice daily required 5.3 pounds of food for a pound of gain, while those fed three times daily required 6.3 pounds for one of gain.

(2) The nutritive effect of grain when fed three times daily was as great as when fed twice daily.

(3) The superior gain of those fed twice was due to greater consumption of food.

(4) Cattle when fed twice daily made a greater gain than when fed three times daily.

(5) Less food was required for a pound of gain for steers when fed twice daily than when fed three times.

Feeding horses (*Utah Sta. Report for 1892, pp. 30–35*).—In this trial a ration of timothy and corn was compared with one of clover, oats and wheat.

Two lots of two working horses were used. These were fed from April 25 to July 2, and then the lots were reversed and the feeding continued until September 1.

The nutritive value of the clover, oats, and wheat ration was 1:5.5, and of the timothy and corn ration 1:14.8.

Analyses of the foods used and the changes in live weight are given. Previous to August 1 the grain was fed unground, and after that date it was fed ground.

The author summarizes his results as follows:

(1) Corn meal and timothy did not sustain work horses as well as oats, wheat, and clover hay.

(2) Horses did as well when receiving whole grain as when receiving ground grain.

(3) A ratio of 1:14.8 was not as effective as one of 1:5.5.

(4) It appears that a narrow nutritive ratio or one rich in protein was better for working horses during summer heat than the very wide nutritive ratio fed.

(5) Presumably a wide nutritive ratio would be more satisfactory in winter than in summer.

VETERINARY SCIENCE AND PRACTICE.

J. F. DUGGAR, *Editor.*

Experiments with mallein, W. B. NILES (*Iowa Sta. Bul. No. 20, Feb., 1893, pp. 729–731*).—An experiment in the use of mallein as an aid in the diagnosis of doubtful cases of glanders was made on two horses with glanders and on two healthy animals used as checks.

The mallein, which was furnished by the Bureau of Animal Industry of the U. S. Department of Agriculture, was prepared as follows:

"Acid peptonized beef-broth cultures, containing 5 per cent glycerine, were inoculated with the glanders bacillus and the cultures allowed to grow for two months at the temperature of the room. At this time the growth, which had been abundant, had almost entirely ceased. The liquid was then heated for two hours from 80° to 100° C., after which it was filtered through a Pasteur tube to remove germs. The resulting clear amber liquid, after being tested to prove the absence of germs and diluted with 5 per cent glycerine for the better preservation, was used for injection."

One of the glandered animals, whose temperature at the time of injection was 98.9°, showed a temperature of 102.6° twelve hours after the injection; the other glandered horse, whose temperature at injection was 99.4°, gave a maximum temperature of 103.8° nine hours after the injection. In the healthy animals no marked increase of temperature took place. Post-mortem examinations revealed the lesions of glanders in the animals which were suspected of having the disease, and in which the presence of glanders was indicated by the mallein test.

The results show that, in these cases, mallein was a positive test for glanders.

Colic in horses and mules, T. BUTLER (*Mississippi Sta. Bul. No. 25, June, 1893, pp. 10*).—This popular treatise is intended for the use of those farmers who are compelled to treat their own stock. The subjects discussed are the causes of colic; the nature, symptoms, and treatment of spasmodic colic; the nature, symptoms, and treatment of flatulent or wind colic; acute indigestion; and inflammation of the bowels.

Eye diseases of domestic animals, C. A. CARY (*Alabama College Sta. Bul. No. 43, May, 1893, pp. 79*).—This bulletin is a popular compilation and is prefaced by a description of the anatomy of the horse's eye.

The following diseases are discussed: Inflammation of the eyelids; entropium, or folding inward of the lid; ectropium, or folding outward of the lid; ptosis, or falling of the upper lid; diseases of the haw, or membrana nictitans; diseases of the tear apparatus; dis-

eases of the tissues surrounding the eye and in the orbital cavity; conjunctivitis; wounds of the cornea; keratitis or corneitis; infectious conjunctivitis and keratitis, or infectious inflammation of the conjunctiva and cornea; ulcer of the cornea; opacities of the cornea; staphyloma of the cornea; new growths on the cornea; iritis, or inflammation of the iris; closure of the pupil; cataract; amaurosis, or paralysis of the retina or optic nerve; glaucoma; hydrophthalmus; exophthalmus, or dislocation of the eyeball; and periodic ophthalmia, or moon blindness.

Under the heading, "Animal parasites of the eye," *Filaria papilosa* and *F. lachrymalis* are described. Squinting, cross-eye, or strabismus is mentioned, and some of the causes of indistinct vision and shying are treated. One hundred and thirty-four cases of periodic ophthalmia in Alabama were reported to the author. At some length the author indicates the best methods of examining the eyes.

Head scab of sheep, diphtheritic conjunctivitis of turkeys and chickens, cerebritis or blind staggers, "big head" (*Osteo porosis*), parturient apoplexy or milk fever, hog cholera, and pink eye are the diseases reported to the author as occurring in different parts of the State.

DAIRYING.

E. W. ALLEN, *Editor.*

The effect of setting milk warm or cooled upon the separation of cream, W. H. CALDWELL (*Pennsylvania Sta. Report for 1891, pp. 118–123*).

Synopsis.—Five trials made to compare the effect of setting milk at once at its natural temperature, and of first cooling it rapidly 10° to 20° and then setting, failed to show any marked uniform difference in the thoroughness of creaming or in the churnability of the cream.

To compare the thoroughness of the separation of the cream in cold deep setting, when milk was set at once at the temperature at which it was drawn, and when it was first cooled, five series of trials were made. Each series included from four to six separate trials. They were made during the months of June, July, and November. In each case the milk was taken from the stable to the spring house as soon as milked. There it was divided into two equal portions, one portion being set at once, the temperature of the milk when set ranging from 82° to 94° F. The other portion was cooled by a Heuling milk cooler and ærator and then set, its temperature at time of setting ranging from 54° to 69° F. In four trials the milk was skimmed after twenty-four hours, and in one trial after twelve hours.

The milk was from the station herd of Guernsey and grade Guernsey and Jersey cows.

In three of the four trials when the milk stood twenty-four hours in the creamer more fat was found in the skim-milk from the lots set warm. In the other trial and the one where the milk stood but twelve hours, more fat was found in the skim milk

from the lots cooled before setting. The average of the four lots set twenty-four hours show 0.08 per cent more fat in the lots set warm. The difference in the one trial where the milk was set but twelve hours was only 0.009 per cent. These differences are unessential and agree with the results obtained at the Cornell University and Maine Stations and with the later results at Wisconsin.

The churning record is also given for the cream raised by different methods of treatment in three trials. This record showed no marked differences in churnability of the cream which could be attributed to the difference in treatment of the milk before setting.

Deep vs. shallow setting of milk, C. S. PLUMB (*Indiana Sta. Bul. No. 44, May, 1893, pp. 24–27, fig. 1*).

Synopsis.—Twenty-four comparative trials were made in winter of setting milk in deep and in shallow cans in the open air, and skimming after twenty-four hours. In all but four cases the skim milk from deep setting contained considerably more fat than that from shallow setting, the average loss from deep setting being nearly twice as much as that from shallow setting. Seven churn tests of the cream obtained showed a much larger loss of fat in the buttermilk from the shallow than from the deep setting, although the losses were excessive in both cases.

Ten comparisons of these two methods of setting milk were made in December and fourteen in February. The milk of the station herd was divided into two portions, one being set in deep cans and the other in shallow pans. The deep cans were of the Shotgun pattern, 20 inches deep and 8 inches in diameter, and were skimmed from the top with a conical dipper. The cans were not set in water, but as the tests were made in winter a temperature of about 45° F. was secured. The milk in shallow pans attained a temperature of about 42.8°. The milk was in all cases skimmed after twenty-four hours' setting.

The fat tests were made with the Babcock milk tester. The milk set contained on an average 3.6 per cent of fat. The percentage of fat in the skim milk from the deep setting ranged from 0.25 to 1.45 per cent, and averaged 0.92 per cent; and that from setting in shallow pans ranged from 0.17 to 1.12 per cent, and averaged 0.47 per cent. The loss was, then, nearly twice as great in deep setting as in shallow setting at the temperature prevailing.

Slightly more cream was secured from shallow setting than from deep setting.

Seven churn tests were made with the cream obtained in the above trials. The percentage of fat in the buttermilk averaged 0.46 for the deep setting and 0.85 for the shallow setting.

"It is noticeable that in every churning a greater loss of fat occurs from shallow-pan buttermilk than from deep can, the average for the seven churnings being nearly 100 per cent greater. The cause for this difference in loss is not made clear to the writer, and further experiments in churning the two classes of cream should substantially duplicate the results secured from the seven churnings, before it can be assumed that these relative losses will probably occur as a general thing. In either lot the loss of fat is greater than it should be."

Surface vs. bottom creaming of milk set in deep cans, C. S. PLUMB (*Indiana Sta. Bul. No. 44, May, 1893, pp. 28–31, fig. 1*).

Synopsis.—Twenty-two comparisons made during January and February in skimming milk from Shotgun and Cooley cans set in the open air. More cream was secured in skimming from below (Cooley cans). The loss of fat in the skim milk was nearly twice as large by skimming from above with a dipper (Shotgun can) as by drawing the skim milk from below.

During January and February twenty-two trials were made, setting the milk in deep cans in the open air and skimming from the top (Shotgun can) and from the bottom (Cooley can). In all 1,054 pounds of milk were set and skimmed by each method.

A considerably larger volume of cream was obtained in skimming from below than from above, the exact amounts being 334 pounds and 265 pounds, respectively; hence the volume of skim milk was larger where the milk was skimmed from above.

The average percentage of fat in the skim milk was 0.27 in skimming from below and 0.5 in skimming from above. The actual amount of fat lost in skimming from above was twice that lost in skimming from below.

Reference is made to experiments in the same line by Babcock, reported in Bulletin No. 29 of the Wisconsin Station (E. S. R., vol. III, p. 480), which "showed no material difference in the efficiency of the two methods if the skimming was carefully done and the same amount of cream taken in each case."

Influence of dilution upon creaming milk, C. S. PLUMB (*Indiana Sta. Bul. No. 44, May, 1893, pp. 32–36*).

Synopsis.—Fourteen comparisons of diluting milk one-half with warm and with cold water and of setting undiluted showed a positive loss from dilution, the loss being least where warm water was used for diluting.

To test the efficacy of diluting milk with warm and with cold water before setting, fourteen trials were made during February, using Cooley cans submerged in cold well water. Ninety pounds of milk were set each day, 30 pounds being diluted with cold water (about 46° F.), 30 pounds with warm water at about 93° F., and the remaining 30 pounds set undiluted. The temperature of the water in the creamery averaged 45.7° F. The milk was skimmed after about twenty-three hours. A considerably larger quantity of cream was secured when the milk was diluted, due to the fact that the cream retained more water. Correcting the analyses of the skim milk for the water added, it is found that on an average the percentage of fat in the skim milk was 0.36 for cold dilution, 0.27 for warm dilution, and 0.2 for undiluted milk. "These figures seem to show most conclusively that it is unwise to dilute milk for the purpose of securing more effective creaming, and that in fact dilution is a positive detriment."

Reference is made to experiments made elsewhere, the majority of

which indicate no advantage from dilution with either warm or cold water.

Aëration of milk, C. S. PLUMB (*Indiana Sta. Bul. No. 44, May, 1893, pp. 37–39*).

Synopsis.—A study of the effect of aërating milk on the thoroughness of the creaming showed no particular advantage from aëration, the yield of cream and of butter being practically the same whether the milk was aërated and or not.

The object of these trials was to determine the effect on the thoroughness of the creaming of aërating and cooling milk previous to setting. An Evans & Heuling aërator was used, which rapidly reduced the temperature of the milk. Fifteen trials were made during May, in each of which 50 pounds of milk from the station herd was divided into two parts, one part being set at once in submerged cans and the other aërated and then set under similar conditions. Both lots were skimmed after twenty-four hours. The temperature of the aërated milk at setting was about 56.5° F. and of the milk not aërated, 88.3°; and the temperature of the water in which the cans were submerged averaged 54.5° F.

In the fifteen trials 183 pounds 5½ ounces of cream were obtained from the aërated milk and 181 pounds 10½ ounces from the milk not aërated.

The average percentage of fat in the cream was 24.4 for the aërated milk and 24 for that not aërated. Slightly more fat was secured from the aërated milk.

Eleven churning tests made with the two kinds of cream gave a yield of 6 ounces more of butter from the cream from aërated milk.

A study of the work thus far recorded indicates no gain in yield of fat through aërating milk.

It was noted during the test that the aërated milk kept sweet a few hours longer than that not aërated. On the evening of May 16th and the morning of the 17th two lots of milk were treated as before, excepting that skimming was postponed. On the morning of the 18th the aërated milk set on the 16th was sweet, while that not aërated was slightly acid, and on the 19th that sweet the day previous was sour, while the slightly acid was quite sour. The milk set aside on the morning of the 17th gave results similar to the other two lots.

The Baby separator in the private dairy, C. S. PLUMB (*Indiana Sta. Bul. No. 44, May, 1893, pp. 40–43, figs. 2*).—An illustrated description is given of the Baby separator and the results of six tests made at the station on the effectiveness of the machine. Mixed milk of the herd, Jersey milk, and Holstein milk were used in separate cases. In every case the fat in the skim milk was 0.1 per cent. Results of similar trials at the Wisconsin Station are cited from Bulletin No. 29 of the station (E. S. R., vol. III, p. 480).

Directions for using the Babcock milk test and the lactometer, S. M. BABCOCK (*Wisconsin Sta. Bul. No. 36, July, 1893, pp. 31, figs. 6*).—"This test was first described in Bulletin No. 24 issued by the Wisconsin Agricultural Experiment Station in July, 1890. A description of it

was also printed in the Seventh Annual Report of the station, which appeared early in 1891. The demand for these publications, growing out of the extended use of this test by dairymen and breeders in all parts of the world, was so great that the editions were soon exhausted, and Bulletin No. 31, giving fuller information regarding the use of the test, was issued in April, 1892. The entire edition of this bulletin, comprising 10,000 copies, has already been sent out, and it is necessary to describe the test again in order to supply the numerous calls which are received."

The present bulletin is practically the same as Bulletin No. 31 of the station (E. S. R., vol. IV, p. 193), with some minor precautions suggested by further use of the method.

Occasionally [sulphuric] acid is obtained which is of the proper strength, but which, owing to some impurities, fails to give a clear separation of the fat. Two or three lots of such acid, which blackened the fat even when used in small quantities, and with which it was impossible to obtain satisfactory results, have been met with. The cause of the trouble is unknown, and the best remedy is to change such acid for that from a different lot, as most of the sulphuric acid which has the correct specific gravity will be found to give good results. * * *

If [when the bottles are filled with hot water] clots of curd or other matter are mingled with the fat, making the reading uncertain, the difficulty can usually be avoided by adding the hot water in two portions, filling the bottle at first only to the neck and after whirling for about one minute adding sufficient hot water to bring the fat into the graduated neck, after which the bottle should be whirled and the fat measured. * * *

[In testing skim milk or buttermilk] if only traces of fat appear in the neck of the bottle, the fat in the milk examined may be nearly 0.1 per cent., and this reading will be more nearly correct than estimates of from 0.01 to 0.05 per cent which often appear in the agricultural papers. The reason for this is that minute quantities of fat are either dissolved or not separated by the method. The amount of fat lost in this way is about the same for all milk; it is compensated for when sufficient fat is present to form a complete layer across the neck of the bottle by reading to the point where the fat meets the glass instead of at the concave surface. * * *

The examination of cheese is not as satisfactory as that of other dairy products. The chief reason for this is the unequal distribution of moisture and fat in the cheese, making it very difficult to obtain representative samples. On account of this, tests made from different parts of the same cheese, especially if it be very rich, often vary as much as 2 or 3 per cent in the amount of fat found. To avoid this, as much as possible, samples should be taken in a uniform manner.

The provisional method for the sampling of cheese, adopted by the Association of Official Agricultural Chemists, is given.

In connection with a discussion of the composite test, a description is given of the method of preserving composite samples with potassium bichromate, as suggested by Alén.

The use of potassium bichromate for the preservation of composite samples of milk has been thoroughly tested with most satisfactory results by students of the Wisconsin Dairy School during the past winter. Samples of milk have been kept in this way, in a warm room, for more than a month without being coagulated, and determinations of fat in these samples at frequent intervals, have shown no change in the amount of fat found. In all one hundred and fourteen composite tests were made by this method. Each of these was made up of either four or six samples of milk, rang-

ing from partly skimmed milk containing little fat to very rich milk containing more than 6 per cent of fat. The samples were kept in a warm room from eight to ten days after the first portion was added, and were, without exception, in good condition when the final test was made. All determinations of fat, both in the single and composite samples, were made in duplicate, the bottles containing the tests being shown to the instructor in charge, and a written report given to him each day, of the tests. The final results are given below:

Average per cent of fat in all single samples, 3.676; average per cent of fat in all composite samples, 3.654.

Of the one hundred and fourteen trials there were only four in which the difference between the composite test and the average of the single tests exceeded 0.2 per cent, and in all of these the milk was partially churned by too much mixing, making it impossible to obtain a representative sample of the composite. Of the remaining one hundred and ten trials only ten gave differences larger than 0.1 per cent fat, and in forty trials the composite test agreed exactly with the average per cent of fat in the single tests. These results are far better than we have obtained by any other method, and I believe warrant its adoption in factories.

In making tests on this plan a pint or quart fruit jar should be provided for each patron. Into each of these jars should be placed from one fourth to one half gram of powdered potassium bichromate. This need not be weighed, as the amount can vary considerably without affecting results. The amount specified is about one half as much as would lie upon a cent, or as much as can be taken upon a pen-knife blade 1 inch long. This will be sufficient to preserve from a pint to a quart a week. A little experience will teach one how much to use; enough should be used to tint the whole sample a light straw color, and it should be perfectly liquid when the final test is made; if this is not the case, more should be used.

Each jar is labeled or numbered to designate the patron to whom it belongs, and into it is placed a measured sample of his milk each day until the test is made.

A small tin cylinder, holding from 1 to 2 ounces of milk when filled to the brim, makes a convenient measure for this purpose. Whenever a fresh sample of milk is placed in the jar it should be mixed with the milk previously added, by giving the jar a rotary motion; unless this is done the cream which separates may adhere tenaciously to the sides of the jar and prevent the taking of an accurate sample when the test is made. The jars should be tightly closed after each sample of milk is added, and should be kept in a cool place during the week.

If kept too warm the cream will become so hard that it can not be mixed with the sample without danger of churning, which will always lead to low results. The test of the composite sample is made in exactly the same way as with fresh milk.

This method of preserving composite samples has been patented by Mr. Alén in Sweden, but so far as I know no restrictions are placed upon its use in this country.

A volumetric method for the determination of fat in butter, G. L. HOLTER (*Pennsylvania Sta. Report for 1891, pp. 134–137, fig. 1*).—The method proposed is a modification of the Babcock milk test. The same machine and acid are used as in testing milk, but in place of the milk-test bottle a bottle holding about 20 c. c. and having a separable graduated neck with a large bulb is used. The capacity of the graduated neck is 9 c. c. In making the test the sample of butter is melted and thoroughly mixed and then 10 c. c. pipetted into a tared test bottle. After thoroughly cooling, the bottle and contents are weighed, the butter again melted, about 5 c. c. of hot water added, and then from 2 to 5 c. c. of the sulphuric acid. After whirling in a machine, hot water is added to bring the separated fat up into the graduated neck where it is read off at 60° C.

Three comparisons of this method with the gravimetric method gave the results agreeing within 0.11 per cent. Parallel determinations with the method on the same sample of butter gave quite wide differences in a number of instances.

Experiments in the manufacture of cheese from normal milk rich in fat, L. L. VAN SLYKE (*New York State Sta. Bul. No. 54, n. ser., May, 1893, pp. 227–260*).—These experiments were supplementary to those made in 1892 and were with milk containing from 3.65 to 5.25 per cent of fat. The experiments were carried on at a cheese factory. The data obtained including analyses of the milk, whey, and cheese, are fully tabulated and the results summarized. The following summary is taken from the bulletin:

Loss of milk constituents in cheese-making.—The amount of milk solids in 100 pounds of milk that was lost in the whey in cheese-making varied from 5.95 to 6.58 pounds, and averaged 6.27 pounds. This was equivalent to from 41.88 to 49.44 per cent of the solids in the milk, with an average of 44.80 per cent.

The per cent of solids in the milk lost in the whey diminished as the fat increased.

The amount of fat in 100 pounds of milk that was lost in the whey in cheese-making varied from 0.17 to 0.49 pounds, and averaged 0.29 pounds (nearly 5 ounces). This was equivalent to from 3.54 to 10 per cent of the fat in milk, with an average of 6.36 per cent. The proportion of fat in milk that was lost in cheese-making was entirely independent of the amount of fat in the milk. The variations in loss were due either to the condition of the milk or to some special conditions employed in manufacture.

The amount of casein and albumen in 100 pounds of milk that was lost in the whey in cheese-making varied from 0.74 to 0.94 pounds, and averaged 0.85 pounds; this was equivalent to from 22.14 to 24.40 per cent of the casein and albumen in the milk, with an average of 23.30 per cent.

The proportion of casein and albumen lost in cheese-making was, in general, very uniform and was little influenced by variation in the conditions of manufacture.

Influence of composition of milk on yield of cheese.—From 100 pounds of milk there were made from 9.75 to 14.20 pounds of green cheese, the average being 12.35 pounds.

There were from 7.04 to 10.25 pounds of milk required to make 1 pound of cheese, 8.10 pounds being the average.

The amount of water retained in the cheese made from 100 pounds of milk varied from 3.20 to 6.39 pounds, and averaged 4.70 pounds.

The amount of fat retained in cheese made from 100 pounds of milk varied from 3.38 to 4.96 pounds, and averaged 4.27 pounds. The variation in the amount of fat retained in the cheese made from 100 pounds of milk followed very closely the variation of fat in 100 pounds of milk.

The amount of casein and albumen contained in the cheese made from 100 pounds of milk varied from 2.35 to 3.11 pounds, and averaged 280 pounds. Each pound of fat produced from 2.53 to 3.23 pounds of cheese, the average being 2.71 pounds.

Study of the cheese-ripening process, L. L. VAN SLYKE (*New York State Sta. Bul. No. 54, n. ser., May, 1893, pp. 261–269*).—In October, 1892, several cheeses were made under different conditions with special reference to use in studying chemical changes occurring during ripening. The observations here reported were on these different cheeses. Cheese No. 1 was made from milk to which cream was added; No. 2 from milk partially skimmed; No. 3 from milk exposed to foul air; No. 4, under conditions favoring the retention of an excessive

amount of water in the cheese; and Nos. 5 and 6 with different amounts of rennet, the former with 3 ounces of Hansen's rennet extract, and the latter with 9 ounces. Analyses are given of the cheeses when green and when five months old, and from these analyses compilations are made of the amount of ingredients in cheese made from 100 pounds of milk. The analyses of these cheeses are tabulated below.

Composition of cheese when green and when five months old.

No.	Conditions of manufacture.		Water.	Total solids.	Fat.	Casein and albumen.	Casein.	Albumen and soluble casein.	Sugar, ash, etc.
			Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
1	Milk with cream added	Green	38.15	61.85	38.13	19.53	18.89	0.64	4.19
		At 5 months	29.85	70.15	44.33	21.53	13.30	8.23	4.29
2	Partially skimmed	Green	42.71	57.29	23.13	28.10	26.94	1.16	6.06
		At 5 months	38.10	61.90	27.22	30.09	21.21	8.88	4.59
3	Milk exposed to foul air	Green	37.58	62.42	35.44	23.60	22.58	1.02	3.38
		At 5 months	31.94	68.06	39.95	25.39	17.22	8.17	2.72
4	Cheese unusually moist	Green	42.90	57.10	30.84	22.91	21.29	1.62	3.35
		At 5 months	33.79	66.21	36.65	26.21	18.74	7.47	3.35
5	3 ounces rennet extract	Green	39.60	60.40	32.12	23.81	23.00	0.81	4.47
		At 5 months	35.69	64.31	36.32	25.52	16.02	9.50	2.47
6	9 ounces rennet extract	Green	39.56	60.44	32.20	24.31	23.55	0.76	3.93
		At 5 months	34.67	65.33	36.36	25.39	13.36	12.03	3.58

Loss of cheese ingredients in ripening.—In five months the loss of weight varied from 10.65 to 17.20 pounds for 100 pounds of cheese and averaged 13.53 pounds.

In five months the loss of water for 100 pounds of cheese varied from 8.14 to 14.95 pounds and averaged 10.60 pounds; this was equivalent to from 20.56 to 34.83 per cent of the water in the cheese, with an average of 26.58 per cent.

In five months the loss of solids for 100 pounds of cheese varied from 1.57 to 3.90 pounds and averaged 2.88 pounds; this was equivalent to from 2.50 to 6.80 per cent of the solids in the cheese, with an average of 4.82 per cent.

There was practically no loss of fat in five months.

In every case there was a loss of casein (nitrogen compounds) varying in amount from 0.90 to 2.20 pounds for 100 pounds of cheese, and averaging 1.48 pounds; this was equivalent to from 4 to 7.83 per cent of the total casein in the cheese, with an average of 6.15 per cent.

Changes in form of casein in ripening of cheese.—In every case the amount of soluble nitrogen compounds increased very much in five months. In the cheese, when green, the amount of nitrogen in soluble form varied from 0.10 to 0.26 pound in 100 pounds of cheese, and averaged 0.16 pounds, which is equivalent to from 3.12 to 7.19 per cent of the total nitrogen in the cheese, with an average of 4.23 per cent. When five months old, the amount of soluble nitrogen varied from 0.98 to 1.70 pounds in 100 pounds of cheese and averaged 1.24 pounds, which is equivalent to from 28.57 to 47.33 per cent of the total nitrogen in the cheese, with an average of 35.52 per cent.

The cheese, when green, contained no nitrogen in the form of amide compounds, while, at five months, there was contained from 0.26 to 0.50 pound in 100 pounds of cheese, with an average of 0.39 pound, which was equivalent to from 7.58 to 13.93 per cent of the total nitrogen in the cheese with an average of 11.66 per cent.

The cheese, when green, contained no nitrogen in the form of ammonium compounds, while, at five months, there was contained from 0.078 to 0.126 pound in 100 pounds of cheese, with an average of 0.103 pound, which was equivalent to from 2.42 to 3.51 per cent of the total nitrogen in the cheese, with an average of 2.92 per cent.

The cheese in the manufacture of which the largest amount of rennet was used contained considerably more of the soluble nitrogen compounds than did any other cheese at five months.

The cheese made from partially skimmed milk contained the smallest proportion of soluble nitrogen compounds at five months, while the cheese made from milk containing added cream contained, with a single exception, the largest proportion of soluble nitrogen compounds.

Quality of milk, G. H. WHICTHER (*New Hampshire Sta. Report for 1890 and 1891, pp. 201–203*).—A reprint of Bulletin No. 13 of the station (E. S. R., vol. III, p. 86).

Effect of food upon the quality of milk, G. H. WHITCHER (*New Hampshire Sta. Report for 1890 and 1891, pp. 138–155*).—A reprint of Bulletin No. 9 of the station (E. S. R., vol. II, p. 65).

Effect of food upon the hardness of butter, A. H. WOOD and C. L. PARSONS (*New Hampshire Sta. Report for 1890 and 1891, pp. 193–200*).—A reprint of Bulletin No. 13 of the station (E. S. R., vol. III, p. 86).

AGRICULTURAL ENGINEERING.

Irrigation experiments, J. W. SANBORN (*Utah Sta. Report for 1892, pp. 50–63*).

Synopsis.—Experiments on impoverished, gravelly, upper-bench soil indicate that (1) irrigation once in fifteen days gave better results than more frequent or less frequent irrigations; (2) fall irrigation in addition to spring irrigation gave better results than spring irrigation alone; and (3) lateral flow of water in the soil was too slow to benefit adjoining unirrigated plats.

In 1890 the station commenced experiments relating to (1) the frequency of irrigation, (2) fall and spring versus spring irrigation, (3) subirrigation versus surface irrigation, (4) night versus day irrigation, (5) mulching irrigation plats, and (6) the best amount of irrigation water to use. Results of trials of night versus day irrigation are given in bulletin No. 21 of the station (E. S. R., vol. IV, p. 824). The present report is confined to the first and second subjects.

Frequency of irrigation (pp. 51–56).—Six plats of very poor, gravelly soil with hardpan subsoil at a depth of about 1½ feet, 2 by 4 rods in size, with intervening spaces of 3 feet, were seeded to wheat, and six plats to timothy in 1890. The plats received the same total amount of water during the experiment in 1890, but on the first plat the water was applied every eighteen days, on the second every fifteen days, on the third every twelve days, on the fourth every nine days, on the fifth every six days, and on the sixth every three days; in 1891 the first plat was irrigated every three days, the second every eighteen days, and so on; and in 1892 the first plat was irrigated once in six days, the second once in three days, the third once in eighteen days, and so down the list. The yields of wheat in 1890, 1891, and 1892, and of timothy in 1891 and 1892 are tabulated. The following table summarizes the results for both crops:

Yield of wheat and timothy on plats differently irrigated.

	Every 3 days.	Every 6 days.	Every 9 days.	Every 12 days.	Every 15 days.	Every 18 days.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Total yield	332.0	524.0	508.5	576.0	651.0	364.0
Average yield, per plat	66.3	104.8	101.7	115.2	130.2	72.8
Average yield per acre	1,326.0	2,096.0	2,034.0	2,034.0	2,604.0	1,456.0

"These figures tell a somewhat uniform story and surprise us in the showing that, on our gravelly soil, better results are secured when irrigation occurs only once in fifteen days.

"It is seen that beyond fifteen days there is a uniform result—a falling off in yield—and also that irrigation as often as every three days is very deleterious. Once in six, nine, or twelve days is labor lost and a reduction of crop in addition."

Correcting the yield of timothy for moisture found in the air-dry hay did not appreciably affect the result. Moisture in the soil of the different plats was determined July 28. "The extraordinary fact about the moisture of the plats is the exceedingly small ratio of moisture found in them and associated with a crop of wheat above the average of the nation or of the Territory. It was below the amount recognized by students of the question as of imperative necessity.

"It appears either that capillarity is inadequate to draw from an available source—a source that does not appear—for the water table is probably 50 to 100 feet below the upper line of coarse gravel, or that crops adapt themselves to our climatic conditions. In a large number of tests a very low rate of water has been found in the soil."

Pot experiments in the above lines were undertaken. The data secured were "not of such satisfactory character as to warrant publication," but confirmed, in general, the results obtained on the plats.

Fall and spring vs. spring irrigation (pp. 56–63).—In 1891 and 1892 four plats seeded to timothy were irrigated by flooding as follows: "(1) Three times in the spring of 1891; (2) three times in the spring of 1891, and in addition twice in the fall; (3) four feet deep in three waterings in the spring of 1891 and twice in the fall; and (4) four feet deep in the spring of 1891."

The tabulated results show that the average yield per acre of timothy was 1,694 pounds on the fall and spring irrigated plats and 1,474 pounds on the spring irrigated plats, a gain of 216 pounds in favor of the former practice.

"To determine the lateral movement of water, if any, due to irrigation, and its effects on plat irrigation," the yields of wheat during three years on two unirrigated plats adjacent to irrigated plats used in the above experiments were observed. The results, while not conclusive, indicate that the unirrigated plats derived no benefit from a lateral flow of water from the irrigated plats.

Summary of results (p. 63.)—"(1) Fall and spring irrigation appear to have given better results than spring irrigation.

"(2) Water appears to move laterally too slowly, if at all, in our gravelly soil to affect adjoining plats.

"(3) It is probable that the station soil can not represent the gain to be expected from soils having more compact subsoils."

STATION STATISTICS.

Report of treasurer of New Hampshire Station (*New Hampshire Sta. Report for 1890 and 1891, pp. 282–287*).—A financial statement for the fiscal years ending June 30, 1890, 1891, and 1892.

Financial statement and report of director of Pennsylvania Station, 1891 (*Pennsylvania Sta. Report for 1891, pp. 7–17*).—The financial statement is for the fiscal year ending June 30, 1891. The report of the director includes general statements regarding the changes in the station staff, the station farm, equipment, and work of the year.

"During the year four hundred plats have been under experiment, all of which had to be prepared, seeded, cultivated, and harvested separately. Feeding experiments have been made on 50 animals, from 4 to 17 being under experiment at one time. A considerable amount of experimental work in dairying has also been carried on. In the prosecution of this work in field, barn, and dairy 2,397 samples have been taken for partial or complete analyses. * * *

"The work performed in the laboratory during the past year includes 4,487 determinations in connection with the fertilizer work performed for the State Board of Agriculture, and 6,741 determinations in analyzing fodders, dungs, milks, etc., making a total of 11,228 determinations performed during the year; besides a large amount of work not capable of such classification, including tests of methods, apparatus, etc."

Financial statement and report of director of Utah Station, 1892 (*Utah Sta. Report for 1892, pp. 4–14*).—The financial statement is for the fiscal year ending June 30, 1892. The director's report consists of general statements regarding the work of the station, and a summary of Bulletins Nos. 10–19 issued by the station during 1892.

Report of the chemical division of the Utah Station, W. P. CUTTER (*Utah Sta. Report for 1892, pp. 165–170*).—A statement of additions to the laboratory equipment, of work accomplished and in progress, and of experiments with sugar beets.

Sugar beets.—Seeds of two varieties of beets were distributed to twenty-six persons. Of these thirteen returned samples of beets. The analyses of the samples received and of beets grown on the station farm are tabulated. There are also notes giving the experience of the growers.

ABSTRACTS OF PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE.

Contributions from the U. S. National Herbarium (*Division of Botany, Contributions from the U. S. National Herbarium, vol. I, No. 7, July 15, 1893, pp. 233–267*).—A systematic and alphabetic index to new species of North American phanerogams and pteridophytes published in 1892, by Josephine A. Clark.

Report of Death Valley Expedition, part II (*Division of Ornithology and Mammalogy, North American Fauna, No. 7, May 31, 1893, pp. 394, plates 14, figs. 2, maps 5*).—A partial report on collections made in 1891, during a biological survey of parts of California, Nevada, Arizona, and Utah.

Report on birds, A. K. Fisher (pp. 7–158).—A list of 290 species and subspecies is given, accompanied by critical notes as to habits, frequency of occurrence, etc. The known range of several species is greatly extended. A list of 78 species is given as occurring in Death Valley, and 137 species in Owens Valley, California.

Report on reptiles and batrachians, with descriptions of new species, L. Stejneger, with field notes by C. H. Merriam (pp. 159–228).—A list of 56 species is given, with critical notes, of which the following are described as new: *Scelroporus boulengeri, S. orcutti, Phrynosoma cerroense, P. goodei, Gerrhonotus scincicauda palmeri, Hypsiglena texana, Pituophis catenifer deserticola, Bascanion flagellum frenatum, Bufo boreas nelsoni,* and *Rana fisheri.*

Report on fishes, C. H. Gilbert (pp. 229–234).—A list of 13 species and subspecies is reported upon, of which *Rhinichthys velifer, R. nevadensis, Cyprinodon macularius baileyi,* and *Empetrichthys merriami* are new.

Report on insects, C. V. Riley (pp. 235–268).—About 280 species are reported upon, of which many are new. Supplementary reports and descriptions of new species are given by S. W. Williston, P. R. Uhler, and Lawrence Bruner.

Report on mollusks, R. E. C. Stearns (pp. 269–283).—A list of 47 species is given, together with critical notes. One of the species is described and figured as new.

Report on desert trees and shrubs, C. H. Merriam (pp. 285–343).—Notes upon the occurrence and distribution of 145 species of trees and shrubs of the desert and surrounding mountains, and their relation to vertical distribution throughout the great biological zones, are given. The most marked longitudinal divisions, so far as the Great Basin is

concerned, are those of the Lower Sonoran Zone, divided into the *Larrea* belt and the *Grayia* belt, so called from their characteristic vegetation. The latter is succeeded by the true sage brush (*Artemisia tridentata*). The *Larrea* belt is important, from a horticultural standpoint, as it is suited to the requirements of citrus fruits, olives, almonds, figs, and raisin grapes.

Report on cacti, yuccas, and agaves, C. H. Merriam (pp. 345–359).—Notes on the geographic and vertical distribution of 23 species.

List of localities, T. S. Palmer (pp. 361–384).—A list of localities visited by the expedition, together with notes on geographic location, elevation, etc.

Forecasting of thunderstorms in 1892, N. B. CONGER (*Weather Bureau, Bul. No. 9, pp. 54, charts 6*).—A report on investigations during June, July, and August, 1892, in Missouri, Wisconsin, Illinois, Indiana, Michigan, Ohio, Pennsylvania, New York, New Jersey, and the New England States, undertaken by the Chief of the Weather Bureau, with the object of gathering "materials to be utilized in the study of these storms and the attending atmospheric conditions with a view to predicting the occurrence of this class of storms for special localities in time to make the forecast of value to agricultural interests."

A special report on investigations of thunderstorms in New England is made by R. D. Ward, and on thunderstorms in Ohio by C. M. Strong. The results are given in numerous tables and charts, the latter showing "the weather conditions over the United States east of the Rocky Mountain slope at 8 a. m. (eastern standard time), and the thunderstorms which occurred during the day in the different sections of the above-mentioned territory." The principal points brought out by the season's investigations are given below:

> Certain types of thunderstorms travel in well-defined areas eastward from the Mississippi.
>
> There are sporadic thunderstorms developing in the afternoon which occur during heated terms and cover but limited territory.
>
> It is found that two distinct thunderstorm belts may traverse the same territory and that the second storm does not appear to hold its force to the same extent after it reaches the territory which has been covered by a previous storm on the same date. * * *
>
> It is noticed that thunderstorm belts, moving eastward during the day, appear to lose their identity during the night and revive again farther east the next day. * * *
>
> Thunderstorm conditions are usually found on the southeast quadrant of a low area, and generally in the belt of pressure of 30 inches. This is the class of storms which generally has the progressive movement to the east and has approximately the same velocity as the low area. Thunderstorms also occur on the southwest quadrant of the low area, but these are more liable to occur in the afternoon and be sporadic in character. When two low areas are in progress the crest of the high between them is found to be a favored locality for the development of thunderstorm conditions. * * * Thunderstorms are sometimes developed on the northwest quadrant of a low area, but this was only noticed when the temperature changes were sharp and sudden in that section. Storms of this class are rare, of short dura-

tion, violent in action, and cover but a narrow path. Thunderstorm belts are occasionally developed in high areas when the weather conditions are of an unsettled nature, and a long trough of nearly normal pressure extends over a large territory to the north of the center of the high.

While there are no infallible rules to be laid down for forecasting thunderstorms from the daily weather charts, yet there are certain conditions, indicating the development of a thunderstorm belt, which generally follows during the succeeding twenty-four hours. A noticeable feature of the a. m. weather charts for this season was the relation of the thunderstorm belt to the pressure line of 30 inches and the thermal line of 70°. It is found that during the season nearly 90 per cent of the thunderstorms occurred in the belt covered by the isobar of 30 and at or near the isotherm of 70°. The presence of a low area to the west, moving in behind a high area, should be watched with great care, as the thunderstorm conditions are very liable to develop during the afternoon or evening; the sharp curvature of the isobar, especially where it touches or crosses similar sharp curves of temperature, has been found to be of value in forecasting. * * *

In heated terms thunderstorms may be looked for along the line of change in pressure (30 inches) and where the temperature during the afternoon will continue high. These storms are more liable to occur the day after the maximum heat has passed. It is noticed during these periods that thunderstorm conditions are prevalent during the entire afternoon, and in many instances develop dry thunderstorms.

Where known thunderstorm belts exist to the west it is possible to forecast them for the territory farther east in the same manner as rain is now forecasted. The study of the thunderstorms during this season has not established the fact that thunderstorms can be successfully forecasted for any specific locality, although with the aid of telephonic communication it has proved more feasible. The experiment of making forecasts on telegraphic warnings from stations to the west, some 200 miles, has not proved of value as it appears that the belt may move rapidly in and cover the district with storms before the warnings can be issued to the public. With the warning coming from stations farthest west, so that time may be had to issue the warnings to the public, it is considered that the method will meet with more success than during the season just passed. * * *

The forecasting of thunderstorms from the daily weather maps for the season was fairly successful. Of the forecasts issued from Columbus, Ohio, the percentages of verification were: For June, 90 per cent; July, 86; August, 50, the falling off in August being due to the small number of storms which occurred during that month. In Michigan, where the telephone system was used, the following percentages are given: June, 86 per cent; July, 85; August, 78. It must be considered that an effort was made to forecast all thunderstorms, whether light or heavy, and not to forecast the severe storms only. In Mr. R. D. Ward's paper * * * will be found a comparison of the Washington and Boston forecasts for New England, which indicates that the preliminary work in this line has been fairly successful.

A report on the leaf fibers of the United States, C. R. DODGE (*Office of Fiber Investigations, Report No. 5, pp. 73, plates 10, figs. 12*).—The subjects treated at greatest length in this report are the following: Sisal hemp (*Agave rigida* var. *sisalana*), false sisal hemp (*A. decipiens* Baker), pineapple (*Ananassa sativa*), bowstring hemp (*Sansevieria* div. spp.), and New Zealand flax (*Phormium tenax*). In gathering the leaves of the true sisal hemp it was found that the most convenient implement was a large pruning knife with a blade nearly 4 inches long and a hook-like point. It is estimated that a man could cut in a day about a ton and a half of leaves.

Leaves gathered at Indian Key, Florida, showed an average weight of 1.41 pounds per leaf. The actual product of a long ton of these leaves was nearly 79 pounds, besides 22½ pounds of waste. This gives a total of nearly 102 pounds of straight fiber and waste from a ton of leaves. A long ton of leaves from another locality yielded 71 pounds of dried fiber.

Specimens of false sisal hemp growing wild in Florida were determined by Dr. Baker, of the Royal Kew Gardens, England, as *Agave decipiens*, a new species. The two forms, the true and the false sisal, had frequently been confounded, though differing in habit and general appearance.

Throwing out its mass of leaves from the top of a footstalk sometimes 6 feet high, which is the habit of the mature plant, the leaves seem to radiate from a common center like a many-pointed star, while the color is always in strong contrast to the surrounding vegetation. The true sisal plant, on the contrary, sends up its mass of leaves from the surface of the ground, though sometimes with a very short footstalk, this difference alone rendering identification easy, for before the lower leaves of *sisalana* have been cut, as in cultivation, the plant never shows this habit. Other marked differences are: The shorter, narrower leaf in *decipiens* nearly always (on the keys) rolled in at the sides so that a cross section appears like the letter U. In color it is a brighter, more livid green. Its spines, which are very thickly set along the edges, are strongly recurved, and so sharp that it is impossible to go about among the plants without lacerating the flesh or tearing the clothing. Even the young plants, which have not acquired their footstalks, differ so greatly from the young plants of *sisalana*, that no one should mistake them after having had the differences once pointed out. The young *sisalana* grows very erect, the leaves being flatter and of a dark green, and without spines.

The *decipiens* throws out its leaves with a more spreading habit, the lower series usually bent (recumbent) to the ground, the leaves themselves being short, stocky, and with the edges more or less turned up. The color, even in the young plants, is a brighter green than *sisalana*, the *tout ensemble* presenting a particularly marked form of plant. In their manner of poling we find the only similarity between the two, and this doubtless has caused the expensive mistakes so often made by those collecting sisal plants, and through which shiploads have been taken from Florida to the Bahamas in past time. * * *

The poling is not only similar, but the young pole plants are similar, though I soon learned to detect a difference in the stockier appearance of the *decipiens*. But when once fixed in the soil the identity of the species is soon brought out in a marked manner.

Coming to the fiber, we find the strongest mark of difference between the two forms of fiber plants. In *decipiens* it is whiter, finer, softer, and greatly deficient in strength, though it approaches nearer the appearance of the true sisal fiber than that of any of the allied agaves not varieties of the *A. rigida* known commercially.

I found *A. decipiens* growing all along the coast and keys, from Jupiter almost down to Key West, always most abundant in the wilds where *Agave sisalana* was never found.

The true sisal hemp of Florida produces fiber equal in quantity to the Bahamian and of superior quality. The fiber from the false sisal hemp is inferior both in quality and quantity. This species should be carefully avoided by those collecting plants for propagation.

The fiber of pineapple (*Ananassa sativa*) is very fine and soft. Con-

stant immersion in water is said not to injure it. In tests of strength pineapple fiber exhibits superior tenacity.

"The Florida fiber, when simply plunged into cold water for a few moments after coming from the machine and then dried in the sun, came out almost white, with a fineness and softness unequalled by any other leaf fiber that I have extracted. The fiber will be further prepared, and, if possible, spun."

Leaves from one locality in Florida gave a yield of nearly 55 pounds of dry fiber to a ton of green leaves. Another sample yielded 40 pounds of fiber to the ton, and another 42 pounds.

Sansevieria guineensis is the best known form of plant, producing bowstring hemp.

"Careful estimates based on the quantity of *Sansevieria* fiber produced in our experiments would fix the yield at about 40 pounds of fiber to the ton of leaves. The machine made too large a percentage of waste. The *Sansevieria* waste was not weighed, but it is very safe to state that with only reasonable wastage (cut fiber and fiber drawn out with the pulp) the yield of fiber per ton would come nearer to 50 pounds. Even if this is considerably lower than the yield of sisal hemp, the quick growth of the plant, ease with which it can be harvested, and the higher price of the fiber will probably more than make up for the difference in yield of cleaned fiber.

The material is too good for cordage in the usual acceptance of the term. It is so much finer and better than the cordage fibers, so called, that it would doubtless find a use in the manufacture of fine twines, and I think with proper preparation could be made into a fair spinning fiber, and possibly be employed on some new form of manufacture. The fiber is fine, white, and lustrous, the leaves yielding readily to treatment in the machine in the fresh state. The Department fiber will be further prepared and tested."

New Zealand flax (*Phormium tenax*), a native of New Zealand, has been grown in California for several years and thrives in many localities. The fiber is almost white in color, flexible, soft, and of a silky luster. It is stated that a considerable quantity of New Zealand flax fiber has been used in the construction of the "staff," or outer covering of the principal World's Fair buildings at Chicago. It is used to toughen and hold together the plaster and other substances which form this building material.

Besides the plants noted above, mention is made of several conservatory species of agaves.

The maguay (*Agave americana*), ixtle or Tampico (*Agave heterocantha*), and another Florida agave, as yet undetermined, as well as the wild pineapple (*Bromelia sylvestris*), are described.

Forest influences (*Division of Forestry, Bul. No. 7, pp. 197, figs. 63*).—This bulletin contains a series of papers bearing upon the relation of forests to climate, as follows: Introduction and summary of conclusions,

by B. E. Fernow; review of forest meteorological observations; a study preliminary to the discussion of the relation of forests to climate, by M. W. Harrington; relation of forests to water supply, by B. E. Fernow; and notes on the sanitary significance of forests, by B. E. Fernow. Appendixes: (1) Determination of the true amount of precipitation and its bearing on the theories of forest influences, by Cleveland Abbe; (2) Analysis of rainfall with relation to surface conditions, by G. E. Curtiss.

The bulletin consists largely of a review of the work done in Europe in the lines of the various papers.

The influence of forests on climate is necessarily local in its modifications. As to the temperature, the influence is a cooling one. The annual range of temperature in the forest is less than in the open. The relative humidity between forest and open is 2 to 4 per cent greater in the former. Forests may have some effect in the local air currents which they cause, cool currents coming from the forests by day in the lower strata, and warm currents by night in the upper. Removing forests surely permits more destructive blasts to sweep the country.

In their relation to water supply, it is well known that deforestation increases and accelerates evaporation, unfavorably affecting springs. Forests favor subterrranean rather than surface drainage, and in this manner give a more constant flow to the streams.

From a sanitary point of view, forests give protection against sun and wind, and the soil is not favorable for the production of pathogenic germs. The air is probably purer, due to less dust and more oxygen and ozone.

Prof. Fernow summarizes as follows:

"The position of the forest as a climate factor is still uncertain, at least as to its practical and quantitative importance, but its relation to water and soil conditions is well established. As a climate factor it would appear that the forest of the plain is of more importance than that of the mountains, where the more potent influence of elevation obscures and reduces in significance the influence of their cover; as a regulator of water conditions the forest of the mountains is the important factor; and since this influence makes itself felt far distant from the location of the forest, the claim for attention of Government activity and for statesmanlike policy with reference to this factor of national welfare may be considered as well founded. Every civilized government must in time own or control the forest cover of the mountains in order to secure desirable water conditions."

Prof. Abbe shows how difficult it is to obtain accurate records of rainfall with the instruments in general use. The paper on analysis of causes of rainfall with relation to surface conditions completes the bulletin.

Timber Physics, part II, B. E. FERNOW (*Division of Forestry, Bul. No. 8, pp. 92, plates 12, figs. 22, tables 4*).—This bulletin is a report upon the progress made in the investigation of the mechanical and technical properties of our more important woods, a preliminary notice of which was given in Bulletin No. 6 of this division (E. S. R., vol. III, p. 908). The present bulletin is a report on the investigations on the long-leaf pine (*Pinus palustris*). The material for the tests was secured by Dr. Charles Mohr, of Mobile, Alabama. Over 2,000 tests were made of the timber from twenty-six trees selected from four localities. The mechanical tests were made by Dr. J. B. Johnson, of Washington University, St. Louis, Missouri. A brief account of the botanical and technical characteristics and distribution of the species is given by B. E. Fernow; a field report regarding turpentine timber, by Filbert Roth; a chemical study of the resinous contents, and their distribution in the trees, before and after tapping for turpentine, by M. Gomberg; and field records of test material, by Charles Mohr.

A summary of the more important deductions from Prof. Johnson's tests is as follows:

(1) With the exception of tensile strength, a reduction of moisture is accompanied by an increase in strength, stiffness, and toughness.

(2) Variation in strength goes generally hand in hand with variation in specific gravity.

(3) The strongest timber is found in a region lying between the pith and the sap at about one-third of the radius from the pith in the butt log; in the top log the heart portion seems strongest. The difference in strength in the same log ranges, however, not over 12 per cent of the average, except in crushing across the grain and shearing, where no relation according to radial situation is apparent.

(4) Regarding the variation of strength with the height in the tree, it was found that for the first 20 to 30 feet the values remain constant, then occurs a more or less gradual decrease of strength, which finally, at the height of 70 feet, amounts to 20 to 40 per cent of that of the butt log for the various exhibitions of strength.

(5) In shearing and crushing across and parallel with the grain, practically no difference was found.

(6) Large beams appear 10 to 20 per cent weaker than small pieces.

(7) Compression tests seem to furnish the best average statement of value of wood, and if one test only can be made this is the safest.

The confusion of names for the long-leafed pine existing among lumbermen and dealers is mentioned, and some twenty names are given, some of which apply to different species in different localities. Diagnostic characters are given by which the tree may be readily recognized in the forest.

The timber of the long-leaf pine is best distinguished by the following four characteristics:

(1) Width of the annual rings, having usually from 18 to 25 rings to the inch, as against 11 to 12 in the short-leaf and loblolly. Fewer rings to the inch would lend countenance to the suspicion that the material is not long-leaf.

(2) Weight, which for partially seasoned wood averages about 48 pounds, being 8 to 12 pounds heavier than short-leaf and loblolly. The lowest specific gravity found by Prof. Johnson was 0.66 for tree 52, or 38 pounds.

(3) Amount of resin, which produces, when the wood is cut across the grain with a sharp knife, a polished and vitreous or horny appearance of the summer wood. This is, however, not a very reliable sign, as other pines react in the same manner. Whether the presence of large amounts of resin account for the great weight and for superior strength is still an open question.

(4) Thickness of sap-wood, which, at least in the pines now cut for lumber, is rarely over 2 or 3 inches wide, much less than the other pines with which it might be confounded.

In regard to the use of this timber, Prof. Johnson makes the following statements regarding the extensive tests here reported.

The long-leaf pine timber is specially fitted to be used as beams, joists, posts, stringers in wooden bridges, and as flooring when quarter-sawed. It is probably the strongest timber in large sizes to be had in the United States. In small selected specimens, other species, as oak and hickory, may exceed it in strength and toughness. Oak timber, when used in large sizes, is apt to be more or less cross-grained, knotty, and season-checked, so that large oak beams and posts will average much lower in strength than the long-leaf pine, which is usually free from these defects. The butt cuts are apt to be wind-shaken, however, which may weaken any large beams coming from the lower part of the tree. In this case the beam would fail by shearing or splitting along this fault with a much smaller load than it would carry without such defect. These wind shakes are readily seen by the inspector, and sticks containing them are easily excluded, if it is thought worth while to do so. For highway and railway wooden bridges and trestles, for the entire floor system of what is now termed "mill" or "slow-burning" construction, for masts of vessels, for ordinary floors, joists, rafters, roof-trusses, mill-frames, derricks, and bearing piles; also for agricultural machinery, wagons, carriages, and especially for passenger and freight cars, in all their parts requiring strength and toughness, the long-leaf pine is peculiarly fitted. Its strength, as compared to that of short-leaf yellow pine and white pine is probably very nearly in direct proportion to their relative weight, so that, pound for pound, all the pines are probably of about equal strength. The long-leaf pine is, however, so much heavier than these other varieties that its strength for given sizes is much greater.

A great many tests have now been made on short-leaf and on loblolly pine, both of which may be classed with long-leaf as "Southern yellow pine," and from these tests it appears that both these species are inferior to the long-leaf in strength in about the ratio of their specific gravities. In other words, long-leaf pine (*Pinus palustris*) is about one-third stronger and heavier than any other varieties of Southern yellow pine lumber found in the markets. It is altogether likely that a considerable proportion of the tests heretofore made on "Southern yellow pine" have been made on one or both of these weaker varieties.

The report on field investigations of turpentine timber is summarized as follows:

(1) A large proportion of the yellow or long-leaf pine lumber is from bled trees.

(2) It is never kept apart or distinguished from the unbled by either millers or dealers.

(3) No available criteria exist by which to distinguish the two kinds of lumber after manufacture.

It is also plain that the opinions regarding difference in quality, or the influence of bleeding on the timber or lumber, are too contradictory to be convincing, and also that the harm which follows the practice of bleeding lies not in the injury to lumber, but consists in—

(1) Bleeding of trees too small for the sawmill.

(2) Bleeding of tracts of timber not ready for the miller at the time of abandonment.

Careful examination in the laboratory and in the field did not confirm any of the opinions with regard to the effects of bleeding, Some of the most resinous logs were from orchards in South Carolina; some of the "driest" from unbled forests in Alabama. The ordinary "fat streak" is a small wound made and healed over at a time when the place is still at the periphery or outside of the tree; therefore it is sometimes made more than a hundred years before the bleeding occurred. The long reaches of "lightwood" are met in unbled timber. Weight and color are more dependent on the proportion of spring and summer wood than on the amount of resin (except in lightwood) and can, therefore, not serve as distinctions.

The effect of bleeding on the forests appears at first as loss of foliage or thinning of the crown, and some trees are evidently killed in two seasons of bleeding; old abandoned orchards everywhere are the very picture of desolation and ruin. The old long-bled trees of North Carolina are runts, and show that with the methods at present pursued by the turpentine orchardists the extraction of resin may sometimes be carried on for long periods, but not without injury to the health and thrifty growth of the trees.

A brief summary is given of the results obtained in the chemical examination, as follows:

(1) Trees that have been tapped can still contain much turpentine in the heartwood.

(2) Trees that have been abandoned for only one year before felling can contain fully as much turpentine in the heartwood as trees that have been abandoned for five years.

(3) Trees that have not been tapped at all do not necessarily contain more turpentine in the heartwood than trees that have been tapped.

The remainder of the bulletin is taken up with field records and results of the various tests.

Experiments with fertilizers for the prevention and cure of peach yellows, E. F. SMITH (*Division of Vegetable Pathology, Bul. No. 4, 1893, pp. 197, plates 22, charts 11*).

Synopsis.—General statement regarding the disease; enumeration of attributed causes; list of fertilizers employed; meteorology of the regions of the experiments; soil and related agricultural conditions; general condition of the orchards; chemical analyses of healthy and diseased tissues; detailed reports on the experiments.

A report on the experiments conducted during the years 1889–'92, inclusive, on the use of fertilizers as preventive and specific remedies for peach yellows. More than 16,000 trees were experimented upon in orchards of Maryland and Delaware. These trees were in fifteen orchards, representing a variety of soils, elevations, and horticultural methods.

The methods of treatment were (1) curative and (2) preventive. The fertilizers used were: Guano, dried blood, superphosphates, muriate of potash, kainit, kieserite, dissolved bone black, dissolved bone ash, nitrate of potash, nitrate of soda, sulphate of ammonia, hard wood ashes, lime, barnyard manure, and tobacco dust.

Details of over one hundred experiments are given with the results obtained. In some there was an apparent benefit derived, but the improvement was only temporary. Some plats received moderate treat-

ment, others heavy doses. Some were treated in the spring, others in the autumn. In some orchards the fertilizers were plowed in, in others harrowed in. These variations did not appear to have sensibly modified the results.

Based upon the experiments the conclusions of the author are: "(1) Peach yellows can not be cured by any ordinary fertilization of the soil; (2) some reputed cures have been made on trees not affected by yellows; (3) in some cases an improved appearance has been taken for recovery; (4) fertilizers exert no restraining influence and three or four treatments at intervals of six months were not more successful than one or two, or than none whatever. Presumably, therefore, this disease is not due to any imperfection of soil arising from a deficiency of plant foods. This conclusion is strengthened by the fact that most of the trees showed the effects of the fertilizer very distinctly prior to the appearance of the disease."

The following additional inferences are given:

These experiments also appear to admit of the following subsidiary conclusions, which are likewise supported by observations in many other orchards:

(1) Other things being equal, rapidly growing trees appear to be most susceptible.

(2) Growth of crops between trees does not specially favor the development of this disease.

(3) There is no proof whatever that overbearing causes or favors the development of yellows. Almost the whole body of these experiments might be put in counter evidence.

(4) With some exceptions, the blocks which held their leaves into late autumn in 1889, 1890 and 1891 did not develop more cases the following years than the controls which ripened their wood and shed their leaves early.

(5) To a certain extent the origin of trees seems to affect their resisting power. This problem is still under consideration.

(6) The result on treated plats and controls were not confused by any surface washing or side movement of fertilizers through the soil.

(7) The rate of diffusion of the superphosphates and potash salts in the soils of these plats is not known, but it is presumed that toward the close of the experiments these substances must have become pretty uniformly distributed through the soil and upper part of the subsoil, especially as crude sulphate of magnesia was used in many cases to hasten the downward movement of the potash. In any event, the tendency of roots to grow toward a food supply is well known, and the extra growth of the treated blocks is sufficient proof that they made use of the fertilizers.

(8) The effect of nitrogen compounds applied in April or May was visible until late autumn, but not the following season except in one instance which, however, was very well marked.

(9) Tobacco dust produced a distinct effect the following year.

(10) Excess of nitrogen caused an overproduction of wood and foliage at the expense of the fruit. The ripening of the latter was retarded very materially, and on several of the plats a part of the fruit shriveled green.

(11) It is not certain that excess of nitrogen favors the development of yellows (see 1).

(12) Wood ashes applied in spring did not produce any striking effect until the following spring.

(13) If large quantities of potash are desired for peach trees, muriate of potash appears to be a better form for general use than kainit.

(14) The maximum number of cases occurred in one orchard the third year from planting; in several, the fourth or fifth year; in others, the sixth or seventh year; and in one, the ninth year.

(15) The year of most cases was 1887 in one orchard, 1888 in two others, 1890 in several others, and 1891 and 1892 in still others, 1889 being the only year when there was not a maximum in some orchard.

(16) There was an unexpected and great decrease of cases during the very rainy and rather cool season of 1889.

(17) The abnormally mild winter of 1889–'90 does not appear to have exerted any special influence on the progress of the disease.

(18) There was a large increase of cases in Delaware in the season of 1890 during and following a severe drought.

(19) There probably were more cases in Kent County, Delaware, in 1892, than any previous year—at least there was a very large number—and that summer also there was a dry spell which lasted five or six weeks, and a shorter drought in autumn.

(20) That part of an orchard surrounded or bordered by forest is apt to be seriously affected first; but the first cases are not necessarily next to the forest, nor is the disease long confined to any particular part of an orchard.

(21) The results on a number of plats show how necessary it is to have a series of experiments and to be cautious in drawing conclusions.

(22) In some orchards one variety was most affected on the start; in other orchards some other variety; and frequently the same variety proved more resistant in one part of the orchard than in another.

(23) Individual trees show very marked differences in their power of resistance, but all finally succumb.

That peach yellows can not be cured or prevented by manuring the soil is believed to be demonstrated, and it is thought advisable to discontinue this line of work.

Reports of observations and experiments in the practical work of the Division of Entomology (*Division of Entomology, Bul. No. 30, pp. 67*).—This bulletin comprises the reports of the field agents for 1892..

Some beneficial and injurious insects of California, D. W. Coquillett (pp. 9–33).—The principal portion of this report consists of an account of experiences with beneficial insects sent from Australia and New Zealand by Mr. Albert Koebele. Caring for these insects and studying their life history occupied the greater portion of the season. Of the insects imported for the destruction of the red scale insect the most promising seems to be *Orcus australasiæ*. Notes and descriptions are given of all insects received from Mr. Koebele.

The walnut span worm (*Boarmia plumigeraria*) is reported as especially destructive to the English walnut in certain parts of California. It is usually confined to the walnut but is reported on oak, apple, and prune trees. A description of all the stages except the adult is given. Blackbirds are important natural enemies of this span worm as well as a fly, probably a Tachina fly, which is parasitic upon it. Insecticides have been tried with more or less success. Pyrethrum did not destroy this insect when used in water at the rate of 1 pound to 50 gallons. Kerosene emulsion was not effectual. Paris green in quantities varying

from 1 to 50 pounds to 200 gallons of water, to which 20 pounds of soap had been added, was effectively used without injury to the trees.

Experiments are recorded for the repression of the codling moth. Twenty-two pear trees were successfully sprayed with Paris green, 1 pound to 160 gallons of water. To this was added 4 gallons of a resin wash. Only one application was given. Injury to foliage may be prevented by mixing one pound of freshly slaked lime with each pound of Paris green.

Report on insect injuries in Nebraska during 1892, Lawrence Bruner (pp. 34–41).—Destructive locusts are reported upon and their great decrease in number during the season is attributed to insect parasites and a fungus, *Entomophthora.*

Notes are given on the following beet insects: Blister beetles (*Epicauta* sp.), white grubs (*Lachnosterna* sp.), the beet webworm (*Loxostege* spp.) *Mamestra* sp., *Amthomyia* sp., and *Silpha opaca.*

Other insects mentioned are the chinch bug, tent caterpillars, fall webworm, walnut Datana, Cecropia larva, green-striped maple-worm, tussock moth, ash-tree sphinx, *Cœlodasys unicornis*, *Lyda* sp., and the pear-tree sawfly.

Reports on insects of Iowa, Herbert Osborn (pp. 42–48).—Notes are given on the prevalence of the following destructive insects: Bill bugs (*Sphenophorus* spp.), potato-stalk weevil (*Trichobaris trinotata*), diamond-backed moth (*Plutella cruciferarum*), cabbage plusia (*Plusia brassicæ*), imported cabbage butterfly (*Pieris rapæ*), army worm (*Leucania unipuncta*), clover-seed caterpillar (*Grapholitha interstinctana*), *Nomophila noctuella*, *Edema albifrons*, *Papilio cresphontes*, *P. turnus*, *P. asterias*, *Mamestra picta*, *Actias luna*, *Datana angusii*, *Grapta interogationis*, and *Vanessa antiopa.* Contributions to the life history of the following species of Jassidæ are given: *Deltocephalus inimicus*, *D. debilis*, and *Diedrocephala mollipes*, mention of which may be found in Bulletin No. 20 of the Iowa Station (E. S. R., vol. v, p. 62). Plant lice were abundant, the more common being *Myzus persicæ* and *Aphis brassicæ.* A report is made on rather unsuccessful experiments in inoculating white grubs with *Botrytis tenella.*

Report on insects of Missouri for 1892, M. E. Murtfeldt (pp. 49–56).—Miscellaneous notes are given on chinch bugs, bill bugs, Colorado potato beetle, grape Phylloxera, flea beetles, cabbage curculio, *Disonycha collaris* on spinach, sawfly, twelve-spotted Diabrotica, corn-ear worm, and boxelder Gracilaria, and notes on the scarcity of parasites of codling moth and plum curculio. There are also contributions to the life histories of the following species: Osage orange pyralid (*Loxostege maclurœ*), blue-grass worm (*Crambus teterrellus*), *Lasioptera* sp. on honey locust, and *Diplosis* sp. on soft maple.

Experiments in apiculture for 1892, J. H. Larrabee (pp. 57–64).—An account of experiments conducted in coöperation with the Michigan Station. Various broods were tested and the superiority of the Carnio-

lan bees in some points was shown. "Punic" bees were tried but they possess no advantages over others and their irritability is against them. The temporary removal of the queen to prevent swarming was tested, and although there was a slight decrease in the total production of honey, the author thinks such practice advisable as it lessens the amount of labor at swarming time. The subject of wax secretion was investigated.

To determine the amount of honey consumed by the bees in secreting 1 pound of wax, the experiment, first undertaken in 1891, was repeated this year. As the conditions were much more favorable, the results were very gratifying. There was entire absence of a natural honey flow, the weather was favorable, the colonies were of the same strength, and in prosperous condition, they took the food rapidly and built comb readily. The result gives a less amount of honey as necessary to be fed the bees in order to have 1 pound of wax secreted than was obtained in this experiment last year. This was to be expected because of the more favorable and exact condition. Two colonies were taken which I have designated as Nos. 1 and 2. No. 1 was given a virgin queen and no comb or honey. No. 2 was given a virgin queen and empty combs. It was noticed that the bees did not fly from either of these hives as vigorously as from the others of the apiary, and that No. 1 was the more quiet of the two. Twenty-four and a half pounds of food were given, and almost exactly 1 pound of wax was secreted by No. 1. By weighing the combs both before and after being melted and taking the difference, the amount of pollen was ascertained. In both colonies the young queens had begun to lay, having been fertilized during the ten days the experiment was in progress. I now feel confident that more careful work on the part of others who have undertaken to solve this question will give practically the same results as are summarized below

Wax secretion.

	Colony No. 1.				Colony No. 2.			
	Lbs.	*Oz.*	*Lbs.*	*Oz.*	*Lbs.*	*Oz.*	*Lbs.*	*Oz.*
Weight of bees	7	5			7	3		
Gross weight, Aug. 2, with bees			27	8			34	4
Gross weight, Aug. 12, with bees			42	10			56	3
Gross gain in weight 10 days			15	2			22	4
Feed given	24	8			24	8		
Minus honey extracted	12	8			20	8		
Leaves honey consumed	12				4			
Honey consumed by No. 1 in excess of No. 2: 12—4=8 pounds								
Wax secreted by No. 1		$15\frac{1}{2}$						
Pollen in combs at close	1	8			2			
Honey, wax, and pollen removed (8 pounds honey consumed in secreting $15\frac{1}{2}$ ounces of wax)	14	$15\frac{1}{2}$			22	8		

Planting for honey was also tried. Three acres of *Melilotus alba* were sown. While the bees visited it abundantly from July 24 to August 10, yet no appreciable amount of honey was stored up. Bee keepers are urged to turn their attention more to wild honey-producing plants and to alsike clover, Japanese buckwheat, and linden trees as sources from which to obtain honey.

The subject of evaporation of honey to secure greater production and prevent granulation was investigated with the following results:

(1) The method at present promising best results for artificial evaporation is that by solar heat under glass well ventilated. A small portion of a greenhouse or forc-

ing house arranged for conserving the heat of the sun, and so located that honey could be run into the shallow vats directly from the mouth of the extractor and drawn off from the bottom of the vats into marketing receptacles, should give good practical results.

(2) Very thin honey or nectar will not sour as quickly as supposed by many, and may be safely kept during any period of cloudy weather we may have during the hot summer months.

(3) The method of exposing to air in a warm room can not be depended upon to ripen very thin honey, although it may be serviceable for evaporating a very small percentage of water.

(4) The method of evaporating by artificial heat of stove or furnace is expensive and troublesome, requiring constant watching and care and not giving as good results as has been hoped for.

(5) The possibilities in the line of evaporating honey for the purpose of increasing the yield and preventing granulation are very great. A series of experiments to determine the increase in production by extracting freshly gathered honey would be next in order and value. When the utility of this method is fully demonstrated supers with fixed frames and extractors holding whole cases will be used and other apparatus conformable to the needs of the new system.

Two sets of experiments were conducted in feeding extracted honey to colonies in order to obtain comb honey. In one case there was quite a profit secured; in the other it was merely nominal. The author thinks his trials are encouraging, and further work along this line is desirable.

Studies of parasitic and predaceous insects in New Zealand, Australia, and adjacent islands, A. KOEBELE (*pp. 39*).—A report of investigations in the above-named countries on the subject of enemies of the scale insects. Large numbers of specimens were sent to California for trial, a report on which is given in bulletin No. 30 of the Division of Entomology (E. S. R., vol. v, p. 100).

Notes are given on the enemies of scale insects and numerous species are described.

ABSTRACTS OF REPORTS OF FOREIGN INVESTIGATIONS.

Estimation of solids and fat in milk, J. B. KINNEAR (*Chem. News, 68 (1893), No. 1754, pp. 1, 2*).—A few drops of milk (about 1 gram) are weighed out on a thin piece of flat crown glass about $2\frac{1}{2}$ inches in diameter, previously tared, and then quickly dried either in an air bath or by holding over a lamp. As soon as the milk dries down it is loosened with a steel scraper and is then soon brought to a constant weight. From the solids thus found and the specific gravity the percentage of fat may be calculated by Fleischmann's formula or, according to the author, as follows: The milk solids are transferred to a half-ounce stoppered bottle, previously tared, and 3 or 4 c. c. of ether added. The stopper is tied in and the bottle then placed in a boiling water bath for a few minutes. After cooling the bottle is weighed, showing the amount of ether it contains. The clear solution of fat in ether is then poured off as completely as possible into a small tared watch glass, the stopper immediately replaced and the bottle again weighed, showing the amount of ether-fat solution taken. The latter is then evaporated and the fat weighed. From this result the percentage of fat in the milk is calculated by means of a simple formula. "The sole possibility of error arises from the evaporation of the ether during the moment of pouring from the bottle into the watch glass. To the extent of this loss the quantity estimated by difference on the watch glass will be over the truth, and the milk will appear too poor in fat. A small correction * * * may be allowed for this, but an error of $\pm$ 0.05 gram in the ether taken, supposing that to be about three fourths of the whole ether employed, will only amount to 0.06 per cent of fat in the average milk, or 0.01 per cent in skim milk, so that for practical purposes it is hardly worth attention. It would almost disappear if the petroleum spirit were destroyed.

"The whole determination of solids and fat may by this method be completed in less than half an hour, and several samples may be examined simultaneously. An additional recommendation is the simplicity of the apparatus and the economy in the ether employed."—E. W. A.

Kreis's modification of the Reichert-Meissl method of butter analysis.—The modification as described by H. Kreis (*Schweiz. Wochenschr. Pharm., 30, pp. 481–483; abs. in Chem. Centbl., 1893, I,*

No. 4, p. 234) consists essentially in saponifying the fat with concentrated sulphuric acid instead of with potassium hydrate. The author claims that the saponification takes place more rapidly with sulphuric acid than with potassium hydrate, and that under proper conditions there need be little or no decomposition of the products. Five grams of water-free fat are melted in a half-liter Erlenmeyer flask placed in a water bath at 30° to 32° C. for a few minutes, and then 10 c. c. of concentrated sulphuric acid added. The flask is corked, and the mixture of fat and sulphuric acid thoroughly shaken until it becomes perfectly clear, when the flask is again placed in the water bath. After heating 10 minutes 150 c. c. of water is added, the mixture shaken, and immediately distilled. If a part of the fatty acids have separated to the bottom they must first be melted by a very gentle heat. On pure cows' butter the figures by this method differ by only about 0.2, on an average, from those by the Wollny modification. The figures for margarin, etc., are about 2.5 higher than those by the Wollny modification, and the difference between the numbers by the two methods is noticeable in butter containing 20 per cent of foreign fats. In butter containing from 20 to 30 per cent of foreign fats the figure by the sulphuric acid method was about 1.5 higher than that by the potassium hydrate method. A difference between the numbers found for a sample of suspected butter by the two methods might be taken as an indication that the butter was adulterated, provided that the author's observations are corroborated by others.

Pure butter gives with sulphuric acid, after a little shaking, a perfectly clear solution, while mixtures with less than 30 per cent of foreign fats require to be shaken two or three minutes before they are perfectly clear.

J. Pinnette (*Chem. Ztg., 17 (1893), No. 23, pp. 395, 396*) states that in the saponification of butter fat with strong sulphuric acid by the Kreis method sulphurous acid is always generated. This passes into the distillate and affects the results of the titration. He suggests that this source of error may be avoided by oxidizing the sulphurous acid with permanganate solution previous to distillation.

He holds the method to be simpler than the Reichert-Meissl method, and of value in connection with that method in testing for oleomargarin, since the latter method gives somewhat lower figures than the Kreis method.

K. Micko (*Ztschr. allg. österr. Apoth. Ver., 1893, No. 4; abs. in Chem. Centbl., 1893, I, No. 17, pp. 803, 804*) likewise observes the generation of sulphurous acid in the Kreis method, and suggests its oxidation with potassium bichromate. Four c. c. of 4 per cent bichromate of potash solution are added to the distillate previous to distillation, the solution thoroughly shaken, and after about five minutes sulphate of iron solution run in from a burette until a slight excess of iron is present. This

method is said to give figures agreeing well with those by the Reichert-Meissl method.

A. Prager and J. Stern (*Chem. Ztg.*, *17* (*1893*), *No. 27*, *pp. 468*, *469*) likewise observe the formation of sulphurous acid, and propose to remove it by forcing a current of air through the solution just previous to distilling. It was found impossible to remove the fumes completely in this way, so the last traces were removed by conducting a current of carbonic acid through the solution for a few minutes. The carbonic acid in the flask was then displaced by air and the solution distilled. This method gave slightly lower results than the Reichert-Meissl method, but is believed by the authors to be an improvement on the original Kreis modification.

P. Schatzmann and H. Kreis (*Chem. Ztg.*, *17* (*1893*), *No. 31*, *pp. 544*, *545*) review the criticisms of the method mentioned above. They claim that the method as originally described is reliable when it is carried out exactly as described in the original paper. The strength of the sulphuric acid is a matter of great importance. That used by them contained 91.53 per cent of sulphuric acid. The too high results obtained by some observers are attributed to using too concentrated acid. When an acid of the strength mentioned is used they claim that there is no necessity for conducting a current of air through the solution, or of using an oxidizing reagent previous to distilling. They show that Pinnette's modification gives results much too low.

A. Prager and J. Stern (*Chem. Ztg.*, *17* (*1893*), *No. 49*, *p. 880*) made experiments in using acid of the exact strength prescribed by Kreis. On pure butter they secured results agreeing quite closely with those by the Reichert-Meissl method. On mixtures of butter with margarin, however, the results were higher than those by the Reichert-Meissl method, the difference being greater the greater the admixture of margarin. They state, therefore, that the Kreis method may be of use in recognizing adulterations of butter with margarin. The difference was noticeable in cases where only 10 per cent of margarin was added. Some of their results with the two methods are given in the following table:

Results by Reichert-Meissl and Kreis methods.

	Reichert-Meissl method.	Kreis's modification.
Pure butter 1	*27.23	*27.84
Pure butter 2	30.78	29.96
Pure butter 3	31.79	32.28
Pure butter 4	30.14	31.18
Pure butter 5	30.88	31.22
Pure butter 6	31.15	31.12
Butter containing 0 per cent of margarin	26.05	26.63
Butter containing 10 per cent of margarin	23.64	29.50
Butter containing 20 per cent of margarin	21.14	24.53
Butter containing 40 per cent of margarin	16.27	19.35
Butter containing 60 per cent of margarin	11.38	16.09
Margarin	0.85	0.98

* C. C. of deci-normal alkali per 5 grams of butter.

Compared with the Reichert-Meissl method the Pinnette modification usually gave too low results. The results by their own modification described above, compare very closely with those by the Reichert-Meissl method. This was true in the case of pure butter, of butter containing from 10 to 60 per cent of margarine, and of pure margarin. In view of their results they conclude that the removal of the sulphurous acid by means of a current of air can not, as Kreis stated, be regarded as superfluous.

S. Rideal (*Analyst, 18 (1893), July, pp. 165–170*) compared the Kreis modification with the Reichert-Meissl method, using 2.5 grams of melted butter fat and sulphuric acid having a specific gravity of 1.836, and adding about 1 c. c. of strong permanganate solution, as recommended by Pinnette, previous to distilling the volatile fatty acids. In fifteen out of thirty tests of pure butter the sulphuric acid method gave results ranging from 0.1 to 0.6 higher than the Reichert-Meissl method, and in four cases ranging from 0.2 to 0.8 lower than the Reichert-Meissl method. The average figures, leaving out one sample in each case, were 14.42 for the Reichert-Meissl and 14.69 for the sulphuric acid method.

On four samples of margarin and two of lard the sulphuric acid method gave a figure 0.1 to 0.2 higher than the Reichert-Meissl method. "The results for margarin and also for the genuine butters seem to point to the new method giving slightly higher results than the standard Reichert-Meissl."

In a discussion following the above paper, Mr. Hehner said it appeared to him that at present the method did not give results which were comparable with those by the Reichert method. By using 10 c. c. of strong sulphuric acid for hydrolysis, none of which was neutralized, it followed that toward the end of the distillation a very strong solution of sulphuric acid was obtained, and, consequently, there was great risk of sulphurous or some other volatile acid being formed. The sulphuric acid method was inapplicable for estimating the insoluble fatty acids, because the sulpho-oleic acid formed yielded oxyoleic acid on dilution of the solution, and this latter had a different equivalent from that of the fatty acids obtained by ordinary saponification. It should also not be forgotten that while butter fat when mixed with sulphuric acid evolved but little heat, and only suffered slight decomposition, margarin, which often contained much vegetable fat, would, in many cases, undergo a much more profound decomposition, accompanied by the evolution of large amounts of sulphurous acid. The process, therefore, was not applicable to anything but pure butter, or to margarin which contained little or no vegetable oil.—E. W. A.

Weiss's method for determining fat in milk, WEISS (*Pharm. Ztg., 38, p. 87; abs. in Chem. Centralbl., 1893, I, pp. 589, 590*).—Thirty grams of milk are mixed in a 300 c.c. bottle with 3 grams of sodium hydrate solution, and 60 grams of petroleum ether added in small portions, shaking thoroughly each time. If the last portion of ether refuses to

mix with the solution, it is allowed to stand for a few minutes, after which it mixes readily when shaken. After adding 20 grams of alcohol, and shaking, the mixture is allowed to stand for 24 hours, when three separate layers will have formed in it, the upper one, clear and colorless, containing all of the milk fat. A portion of this layer is weighed out, evaporated to dryness, dried at 100° and the residue (fat) weighed.

Instead of weighing the milk and reagents they may be measured, in which case 25 c.c. of milk, 3 c.c. of sodium hydrate solution, and 75 c.c. of petroleum ether are shaken together, and the fat determined as before in 50 c.c. of the fat layer. The result is calculated for 100 c.c. of milk.

Comparisons by Lang (*Pharm. Ztg.*, *38*, *p. 210*) of the Weiss method with Soxhlet's aëromatic method and the Schmid-Bodzynsky method gave very satisfactory results, although the author gives his preference to the Liebermann and Székely method (E. S. R., vol. IV, p. 776).—E. W. A.

Points on the analysis of condensed milk, H. D. RICHMOND and L. K. BOSELEY (*Analyst*, *18* (*1893*), *July*, *pp. 170–174*).—The authors describe the methods used by them in the analysis of condensed milk, and report their experience with a number of other methods. From 15 to 30 grams of the condensed milk are placed in a 100 c. c. flask and diluted to 100 c. c. The weight is then taken, and definite weights of the diluted milk are used for separate determinations.

For total solids and ash 5 grams of milk diluted as above are dried on asbestos to constancy, and the residue afterward incinerated, preferably in a muffle. The fat is estimated in 5 grams of diluted milk by the Adams method, and, as a check, the fat is extracted from the Ritthausen precipitate (see below). "The two methods ,with care, agree well."

As pointed out by the authors in a previous paper (*Analyst*, 18 (1893), June, p. 141; E. S. R., vol. IV, p. 978), the milk sugar and cane sugar can not be estimated by the polariscope as the milk has been heated. The method recommended is that of weighing the copper oxide reduced before and after inversion with citric acid. The results by the Shenstone method* for sugar are corrected by dividing the total polarization by 1.042. This correction has been found necessary.† For casein and albumen the Sebelien method is used.‡ The Kjeldahl determination is made by using a little copper oxide with 30 c. c. sulphuric acid. No sulphide was found necessary. The Ritthausen method for albuminoids is modified as follows: "Dilute 10 grams of the diluted milk with about 200 c. c. of water, add a few drops of phenol phthalein solution, and neutralize with dilute caustic soda solution; add 2 to 2.5 c. c. copper sulphate solution, allow to settle, wash about five times by decantation through a tared

*Analyst, 13, p. 222.

†Analyst, 17, p. 222.

‡Ztshr. physiol. Chem., 13, p. 135.

filter, and then wash on the filter, spreading the precipitate over the filter. Dry slightly in the water oven, extract the fat, dry at 130° C., and subtract the ash. This modification of Ritthausen's method gives good results with all milk products except whey, which contains albumoses produced by the action of rennet." The total acidity is calculated as lactic acid.—E. W. A.

Studies on the composition of butter, H. KREIS (*Schweiz. Wochenschr. Pharm. 30, pp. 449, 450; abs. in Chem. Centbl., 1893, I, No. 12, p. 138*).—In 1888 the Association of Swiss Analytical Chemists accepted 26 as the minimum limit for the Reichert–Meissl figures for natural butter. Unadulterated Swiss butters are found, however, which fall below this limit. The author cites the results of the examination of numerous samples. Three samples were found below 22, eighteen from 22.1 to 24, twenty-four from 24.1 to 26, seventeen from 26.1 to 30, and thirteen above 30. Following are the averages by months: December, 30.3; January, 27.9; February, 28.6; March, 25.4; April, 24.9; May, 23.4; June, 24.1; July, 24.7; August, 23.7; September, 22.7; October, 25.2; and November, 30. All butter samples for which the Reichert-Meissl figures were over 30 were from cows which had recently calved.

The water and fat showed the following extremes: The fat ranged from 83.9 to 91.7 per cent, and the water from 6.8 to 15 per cent—E. W. A.

Recognition of foreign fats in butter, W. JOHNSTONE, (*Abs. in Chem. Centbl., 1893, I, No. 13, p. 631*).—The author claims to have found that pure butter does not contain triolein and tributyrin, but a fat which he designates as "oleovacciobutyrat." His method for recognizing foreign fats in butter depends upon the fact that the relation between the oleic and butyric acids in this fat is constant. An excess of oleic acid indicates the addition of an animal fat, and an excess of butyric acid indicates an admixture of vegetable oil. From the amount of butyric acid found in a sample of butter, the oleovacciobutyrat is calculated by means of the factor $\frac{650}{88}$. The iodine number of the butter is determined and calculated to the proper glyceride by multiplying by $\frac{10}{9} \times \frac{650}{282}$. The butter is not pure unless the results of the two calculations agree. It is claimed that with this method the addition of 3 per cent of foreign fat to butter can be detected. The method is covered by an English patent.—E. W. A.

Note on the detection of adulteration of fresh milk with diluted condensed milk, H. D. RICHMOND and L. K. BOSELEY, (*Analyst, 18 (1893), July, p. 174*).—It is recommended to estimate the milk sugar by the polariscope and if it falls below 52 per cent of the solids-not-fat to make a careful gravimetric determination of the milk sugar by Fehling's test; to determine the acidity; and to estimate the soluble albumin by Sebelien's method. A discrepancy between the gravimetric and polariscopic results for milk sugar affords considerable evidence that the milk has been heated, and if the soluble albumin is

also low the evidence "will be almost conclusive." The limits for fresh milk are given: Albumin 0.35 per cent, milk sugar and lactic acid 55 per cent of the solids-not-fat, and the difference between the gravimetric and polarimetric estimations of milk sugar not more than 0.15 per cent. "The diphenylamine test for nitrates would also afford corroborative evidence if impure well water had been used."—E. W. A.

On the fixation of free atmospheric nitrogen by plants and soils, A. PETERMANN (*Sep., Brussel, 1893, pp. 267–276; abs. in Chem. Centbl., 1893, II, No. 22, pp. 988, 989*).—Barley was grown under a large bell jar supplied with air freed of combined nitrogen by passing through a series of wash bottles. The soil was sterilized previous to the experiment and kept sterile. In other cases both sterilized and unsterilized soil was kept under similar conditions, but no barley was planted. In all cases in which the soil was not sterilized it became covered with cryptogamic vegetation before the close of the experiment. The results were as follows:

Absorption of free atmospheric nitrogen by soils and plants.

	Uncultivated soil.		Barley in sterilized soil.	Uncultivated soil.	
	Unsterilized.	Sterilized.		Sterilized.	Unsterilized.
Nitrogen at beginning of experiment	0.0255	0.0255	0.1084	0.0438	0.0738
Nitrogen at end of experiment	0.0294	0.0240	0.1067	0.0430	0.0769
Gain or loss in nitrogen	+0.0039	−0.0015	−0.0017	−0.0008	+0.0031

The nitrogen stated is that in the soil, or in the soil and plants. It appears from the above results that in the absence of cryptogamic vegetation, that is in sterilized soil, no assimilation or absorption of free atmospheric nitrogen took place. This was true whether barley was grown or the soil remained bare.

There was a slight increase in nitrogen, on the other hand, in the case of unsterilized soils. This explains an increase in nitrogen in spite of the absence of root tubercles, observed by the author in a previous series of experiments* with barley.

The following conclusions seem to the author to be justified: Not only the combined, but also the uncombined, nitrogen of the air may be of benefit to plants. The free nitrogen, however, is not taken up by plants directly from the air, but through the agency of microörganisms which inhabit the soil, and which may enter into peculiar relations with the plant (tubercles of leguminous plants).—E. W. A.

The interchange between leguminous plants and the bacteria causing root tubercles, F. NOBBE and L. HILTNER (*Sächs. landw. Ztschr., 1893, No. 16, pp. 165–169*).—The principal part of this article is devoted to the discussion of the theories and hypotheses of Frank and others on the subject of nitrogen assimilation by plants.

*Chem. Centbl., 1892, II, p. 880

The hypothesis of Frank, that all green plants have the power of fixing the free nitrogen of the air, and that probably the leaves are the chief agents in this work, is not accepted by the authors, at least so far as the leguminous plants are concerned. In this they are sustained by the report of the experiments of Kossowitsch, whose conclusions are given. The authors consider the root tubercles as the parts of the leguminous plants where the free nitrogen is assimilated. The direct agents of assimilation are bacteroids, and not the bacteria themselves. As defined by the authors, bacteroids owe their origin to the checking of the fission of bacteria or, if this is not checked, to the retention of numerous individuals within a common sheath for a considerable time. In this manner they are protected from any injurious effect of the host plant. The exact nature and conditions of their formation are still unknown. They vary with different species of plants; but one of the more common forms is rod-shaped but very much larger than single, individual bacteria. The bacteria probably gain access to the plant through the root hairs from the soil.

The leading question is, in what way are the tubercles of the leguminous plants enabled to fix the free nitrogen? Some investigators consider that there is a sort of symbiosis between the bacteria and the plant. that they stand in a living relation towards each other to the mutual advantage of each. Recently others have claimed that the bacteria directly store up the free nitrogen. The authors think these views untenable.

Experiments were conducted at Tharand with peas and species of *Robinia*. Pea plants were inoculated from pure cultures of pea tubercles. On the young plants there was an abundant production of tubercles, but not being supplied with sufficient soil nitrogen the demand for growth was not satisfied, to the evident injury of the plants. A microscopical examination of the tubercles showed that the bacteria were not changed to bacteroids. However, in a soil containing nitrogen the growth of the inoculated pea plants followed the bacteroid formation, and similar effects were noted on the tubercles. In the experiments with *Robinia* one part was grown in nitrogen-free soil and one in soil containing nitrogen. Each was inoculated from pure cultures of *Robinia* bacteria.

It was found that the plants in the nitrogen-free soil had produced tubercles as large as peas, while in the soil containing nitrogen they were no larger than rape seed. A microscopical examination showed that the increase in the tubercles began simultaneously with the change of the bacteria into bacteroids.

The conclusions of the authors are as follows:

(1) Nitrogen assimilation by *Leguminosæ* is not through the bacteria, but through the bacteroids.

(2) At the time of greatest growth of the plant it is infested with bacteria. At this time the bacteroids increase rapidly in number and the small tubercles also increase, to the ultimate growth of the plant.

(3) The weaker the plant at the time of the inoculation the sooner will the bacteroids be formed, and consequently the more abundant the tubercles; in this way the plant will be strengthened, and the ultimate effect on the whole plant will be greater. Everything points, on the part of the plant, to the assimilation of the free nitrogen following the period when the bacteroids are not fully formed. It continues during their growth and ends with their disintegration. The bacteroids, therefore, are of prime importantance in nitrogen assimilation.

It still remains to show how the free nitrogen is collected by the plant. The availability of the tubercles for this purpose is evident from their swollen form and their network of cells; the water, laden with the nitrogen it has washed from the air, passes through these cells, and the nitrogen is separated and stored up in the tubercles.

It is probable that every genus has its specific bacteria, as some work best on certain plants, very slightly on nearly related ones, and not at all on more distantly related groups.—W. H. E.

The influence of humidity on the development of tubercles on the roots of Leguminosæ, E. GAIN (*Compt. rend., 116 (1893), No. 24, p. 1394*).—The author conducted a series of field experiments at the biological laboratory of Fontainebleau with peas, lupines, and beans to determine the effect of moisture on the tubercle development of their roots.

Similar plats were chosen and planted with seed from the same lots. The only difference in cultivation was in the amount of moisture given them. The temperature at midday was taken, and the surface of the moist soil was 7° C. cooler than the dry soil. At 10 centimeters below the surface the difference was 3° C. The root systems developed in the different plats varied greatly. Those in moist soil spread widely, were full of water, became covered with root hairs, and presented a large surface of young tissues. In the dry soil the roots were less spreading and the epidermis was greatly thickened.

In the moist soil the tubercles of the peas were scattered all over the roots, were five or six times as abundant as in the dry soil, were about four times as large, and ovoid in shape, while in the dry soil no tubercles were produced on the superficial roots. At a depth of about 20 centimeters some tubercles were found of a hemispherical shape and much smaller than those grown in moist soil.

With the lupines the results were similar to those observed for the peas.

On the beans about twenty times as many tubercles were found in the moist soil as in the dry soil, and a microscopic examination showed important differences in the abundance of bacteria present and in the structure of the tubercles.

These observations were confirmed on some spontaneous plants, as *Lotus corniculatus*, *Trifolium procumbens*, and *Orobus niger*.

The experiments show that humidity of soil favors a greater development of tubercles, and, as a consequence, a greater assimilation of free nitrogen.—W. H. E.

New experiments with plants collecting nitrogen and their employment in agricultural practice, H. WILFARTH (*Deut. landw. Rundschau, 1892, Nos. 8, 9, 10, and 11; abs. in Chem. Centbl., 1893, I, No. 22, p. 990.*)—Based upon his investigations, the author recommends the following for green manuring: Lupines for light, sandy soil, as well as on some better soils, and perhaps even upon the best beet soil. On lime and wet soils lupines do not succeed well. For light but not too dry soil serradella and sand vetches are best. For the better soils vetches, yellow clover, and nearly all the other species of clover are recommended.

The above mentioned plants may be used as catch plants between crops. The cost of seed and liability to injury on account of unfavorable climatic conditions must be considered in this connection. The addition of a small quantity of nitrogen, preferably as nitrate of ammonia, is often necessary, that the young plants may have food material for the formation of their root tubercles.

The author also considers the question of soil inoculation. The best results were obtained by using inoculating material from a field which the previous year had grown a good catch crop of the kind of plants to be grown. For such purposes 1 to 1½ tons of soil per acre is sufficient material.—W. H. E.

Studies on the growth of plants, E. GODLEWSKI (*Abhandl. Krakauer Akad. Wissenschaft, math. naturw. Classe. 23, pp. 1–129; abs. in Bot. Centbl., 55 (1893), Nos. 1 and 2, pp. 34–40*).—A report is given on (1) the influence of a number of factors on growth, and (2) the relation which these influences bear to cell growth. The subject of the experiments was the epicotyls of *Phaseolus vulgaris*. The greater part of the work is taken up in describing the details of the experiments, thirty-four in number, which were conducted with the aid of Baranetski's auxanometers. Every experiment was conducted in duplicate and extended over several days. In most cases hourly registrations were made by the auxanometer, but in some they were made half-hourly or sometimes every fifteen minutes. The results of the experiments are tabulated and graphically represented by figures in the text. A summary of the results is as follows:

(1) *The daily period of growth in green plants under ordinary conditions.*—Sachs, as well as Regel, asserts that the daily minimum of growth takes place toward evening and the maximum toward morning, but the experiments made by the author led to an essentially different conclusion. The alternation of the daily period he found by no means constant. Experiments conducted in June, 1888, gave midday and midnight as the maximum and minimum periods, respectively,

while a series in 1889 gave morning as the minimum and evening as the maximum growth period. In 1889–'90 experiments were conducted, showing two maxima and minima daily. These were not constant toward each other, but varied at different times and with different plants.

The difference in the daily periodicity is due, the author thinks, to individual peculiarities of the plants and to the time of the experiment, since plants giving a constant alternation during the winter and spring showed essentially different variations in June.

(2) *Periodicity of etiolated plants.*—Etiolated plants vary exceedingly. In some there is no perceptible periodicity, while in others there is a marked though fluctuating one. In one experiment the periods were well marked one day and were reversed on the next. Continued experiments with such plants show that the periodicity is commonly brief and fluctuating.

(3) *Influence of air moisture.*—A sudden considerable reduction of the moisture of the air—for instance, from 64 per cent to 38 per cent—causes an important reduction in growth. The effect of this reduction may be noticed during the first half hour, after which, the moisture remaining the same, the growth returns to the normal. A sudden important increase in the amount of moisture in the air has an opposite effect. The author shows that the effect of these changes remains but a short time in any case. There is no change in the intensity of growth, but there is a change in the turgescence, and consequently in the turgescent stretching of cells.

(4) *Influence of light.*—The difficulty of bringing a plant grown in the dark out into the light without reducing the atmospheric moisture was a source of hindrance to the author which he gradually overcame. The influence of light upon such a plant gradually asserts itself. Upon bringing such a plant into the light, growth may begin at once, or it may sink for a period of a few hours, after which it will assume its normal growth.

(5) *Influence of temperature of the air.*—The influence of a sudden fall in temperature of from 18° to 6° or 8° C. is very marked. In the first hour growth will be very backward and still more the second hour. A gradual increase from the low temperature was followed by still decreasing growth for a short period. A sudden rise in temperature temporarily stopped the growth, but it was soon resumed. The author found that the epicotyls of *Phaseolus* grew perceptibly at a temperature of 6° C., while the minimum temperature of germination, as given by Sachs, is 9.4° C.

(6) *Influence of temperature of the soil.*—This the author thinks is an indirect rather than a direct influence. A reduction of the temperature of the soil from 20.7° to 5.5° C. caused only an unimportant reduction in the amount of growth. At a temperature of 3° C. there still remained some growth of the epicotyls, due probably to the roots still remaining

functional. With leafy and copiously transpiring plants the temperature of the soil would perhaps have a greater influence.

The second part of the report treats of the causes and methods of cell growth. The author considers the subject under two heads: (1) the stretching of the cell wall through turgescence, and (2) the fixing of the stretched membrane and the decrease in the elastic tension of the cell wall, or the restoration of the extensibility of the walls. These conditions depend upon intussusception and apposition. Rapidity of growth depends not only on the elasticity of the cells, but upon the rapidity with which they are again rendered elastic. The author considers that the turgescent stretching of cells and rapid growth are proportional.

As in the first part, experiments were conducted to ascertain the influence of certain factors on cell growth.

(1) *The entire growth period.*—The author considers that the decrease in growth from the maximum period is due to a decreasing elasticity of the cell wall. An important question remains to be answered, namely, which was first discontinued, the turgescent stretching of the cell, or the membrane growth? In order to answer this question the epicotyl of *Phaseolus* was held up by an auxanometer until no further growth was shown, when it was cut off and marked, from the top, into regular spaces of 15 mm. each, and then microscopically examined. In three experiments there was a uniform shortening of the lower two or three sections, in one case amounting to 3.5 per cent, showing the amount of turgescence was due to the stretching of the tissues. When this turgidity was removed the growth accomplished by it was lost. The author considers the turgescent stretching of cells a necessary condition of their growth.

(2) *The daily growth period.*—The maximum and minimum periods of growth were investigated as follows: Two lots of similar plants under equal conditions were cut off, one at the maximum, the other at the minimum period of growth, and, after marking them off equally, they were examined microscopically. Numerous individual differences were noted, but the common result was that the distance of stretching of the epicotyls was greater at the maximum than at the minimum. In the vicinity of the top of the plants no difference was noted, but with increasing distance from the top the minimum growth showed less elasticity than the maximum. The greater increased growth at the maximum period was due, not to a higher turgidity, but to a greater tension of cell walls.

(3) *Influence of light.*—A green and an etiolated epicotyl, under similar growing conditions, were cut off and examined. For similar parts of each there was no appreciable difference in the turgescent stretching of cells, but in the etiolated plant the cells were stretched more and more as they were removed from the top. The turgescence of the etiolated plant was rather lower than in the green one. The tension of

membranes was less in the light than in the dark. Etiolated plants subjected for some time to the light and then examined showed, in the internodes grown during the illumination, diminished tension of membranes due to the light. The increased growth of the etiolated plants may be attributed to thinner cell walls, and not to greater growth itself.

(4) *Influence of temperature.*—A plant was kept at a temperature of 20° C. and another at 9° C. The difference in intensity of growth was very marked, and there was a corresponding difference in the turgidity. The result of this experiment is similar to some experiments with roots, yet it does not follow that growth is independent of turgescence, nor that the influence of temperature depends, not upon the turgescent stretching of cells, but upon the influence of the rapidity with which the tension of the cell membranes is reduced by the protoplasm.—W. H. E.

Polygonum sachalinense as a forage plant, DOUMET-ADANSON (*Compt. rend., 116 (1893), No. 24, p. 1408*).—The dearth of green forage plants has been so great in Europe this year that numerous investigations have been made upon new or little-known plants that give promise of supplying the deficiency.

The author gives his experience with *Polygonum sachalinense*, which he has grown in Baliene, central France, for several years. It is a native of one of the islands to the north of Japan. It seems perfectly acclimated and grows vigorously on any kind of soil, and as a green fodder is well liked by stock, especially by cattle. It produces six or more cuttings per season after the first year. When not cut the plant attains a height of 6 to 10 feet, with alternate cordate leaves 8 to 16 inches long and 6 to 11 inches wide. The plant branches widely and usually stands thickly upon the ground. It is propagated by cuttings of the "running roots" planted in February. It should be cut twice during the first season whenever it reaches a height of 3 feet; after that it should be permitted to go to seed. The following seasons it should be cut whenever it reaches a height of 3 feet. It will remain green and leafy until frost, and withstands drought very well. The annual amount of green fodder produced is very large.

The author thinks it may be easily kept within bounds by surface cultivation, should it show a tendency to become troublesome.

The usefulness of the plant as a source of dry winter fodder is still to be investigated.—W. H. E.

Pot experiments with potatoes, A. PAGNOUL (*Ann. Sci. Agron., 1892, I, No. 2, pp. 237-249*).—Experiments with potatoes grown in pots of sand showed that the presence of potash almost doubled the amount of tops and nearly trebled the weight of tubers. Nitrogen in the form of nitrate gave a larger crop of tubers than did nitrogen in the form of ammonia. Nitrate of potash was more easily and effectually absorbed by the potato plant than nitrate of soda.

In an experiment to test the effect of light on the growth of potatoes, six plants were grown in good soil; three were fertilized with nitrate of potash and three with the same amount of nitrogen in the form of sulphate of ammonia. Both series received an application of superphosphate. Colored glass was placed above one plant in each series; ordinary glass above one plant in each series; and the other plant in both series was grown under natural conditions. The two plants under darkened glass elaborated 31 and 20 grams of starch, respectively; those under ordinary glass 170 and 110 grams; and those under normal conditions 223 and 361 grams.

Under glass, nitrate of soda gave a larger yield of starch than sulphate of ammonia, but under normal conditions the latter was more effective.

To the favorable influence of abundant light, the author attributes the large yield of potatoes in a season when the aggregate number of hours of sunshine is unusually large.—J. F. D.

Improvement of the potato and of methods of its culture in France, A. GIRARD.—*Means for the improvement of the potato* (*Ann. Agron.*, *17* (*1891*), *No. 73*, *pp. 136–139; Compt. rend.*, *108* (*1889*), *pp. 412–415; 110* (*1890*), *pp. 176–179; 111* (*1890*), *pp. 957–960*).—As the result of ten years of experimenting, the author has succeeded in growing crops of potatoes several times greater than the average crops grown in France. In 1888 he secured a yield of 44,000 kg. of potatoes per hectare, in 1889 the yield was 39,000 kg., and in 1890 the yield of one field exceeded 50,000 kg. per hectare, or more than 700 bushels per acre.

The methods by which the author has so largely increased the yield of potatoes in France are of interest to American cultivators. Having chosen for his experiments the variety Richter Imperator, he selected his seed potatoes every year from those hills whose foliage was especially luxuriant. He prepared the soil to a depth of from 12 to 16 inches, and applied a liberal quantity of stable manure, supplemented by 500 kg. of a rich superphosphate, 300 kg. of sulphate of potash, and 200 kg. of nitrate of soda per hectare (about 900 lbs. of mixed mineral fertilizers per acre). He selected for planting tubers weighing from 80 to 120 grams. When it is impossible to use tubers of this size he recommends that tubers of 200 grams be cut in half and tubers of 300 grams be cut into three pieces, always cutting in the direction of greatest length. He insists on the rejection of all potatoes weighing more than 300 grams. Should the potatoes available for planting weigh less than 80 grams he places in each hill several of the small tubers, so that the total weight in each hill is from 80 to 120 grams. He lays great stress on the distance between the plants. The rows are 24 inches apart, and the tubers are planted at a distance of 19 inches in the row. He advises planting as soon as danger of hard frosts is past. The crop should be well worked and all the growing tubers kept covered with

the soil. Bordeaux mixture should be sprayed on the plants as a preventive of the potato blight, and the crop should not be dug until every portion of the plant has withered.

Improved methods of cultivating the potato (*Ann. Sci. Agron., 1892, I, No. 2, pp. 250–295*).—In 1891 about 350 farmers in different parts of France conducted experiments under the author's directions. Most of these used the seed of Richter Imperator which had been improved by the author through a number of years. In some cases the area on a single farm was as much as 11 hectares. One hundred and ten of these farmers, by following the author's directions, and by conducting their experiments on fertile land, secured harvests ranging from 30,000 to 50,000 kg. per hectare, or approximately 446 to 740 bushels per acre.

Those who neglected directions, either as to depth of preparation of the land, distance of planting, amount of fertilizer, or planting of whole potatoes, secured much smaller yields.

Considering first the 110 farmers whose crops were grown on fertile soil, we find that 59 of these harvested from 30,000 to 35,000 kg. per hectare; 21 secured 35,000 to 40,000 kg.; 16 obtained 40,000 to 45,000 kg.; and 14 harvested 45,000 to 50,000 kg. The average yield on this class of soil and for the farmers who followed directions was 36,250 kg. per hectare. This average would have been much higher had not the author rejected from his calculations all plats whose area was less than one-fifth of a hectare. On some of these small plats the yield was enormous. One farmer on 44 square meters harvested at the rate of 91,000 kg. of potatoes per hectare, which is a yield of 1,353 bushels per acre.

Average samples were sent to the author and analyzed by him. Of 150 samples analyzed 51 showed from 20 to 25 per cent of starch. The starch content of 82 per cent of these samples ranged from 18 to 22 per cent. These figures the author takes as representative of the results which may ordinarily be attained by following his methods. All samples whose content of starch was above or below these figures he considers as the result of exceptional conditions. He proposes to investigate the cause of this variation of 3 to 4 per cent in ordinary samples by studying in future the detailed information furnished by the cultivators. The average starch content in 1891 was 20 per cent, an increase of 0.5 over the average of the preceding year.

One farmer secured 11,128 kg. of starch per hectare, or nearly 10,000 pounds per acre. The average amount of starch per hectare on good land properly managed was 7,245 kg. The author believes that never before did a hectare produce such a large amount of carbohydrates suitable for manufacturing or for food.

By the use of the author's cultural methods, 23 cultivators on poor soil attained an average of about 23,000 kg. of potatoes per hectare, with an average starch content of 19.7.

In 1891, 68 of the farmers conducting the experiments departed from instructions in one or more points, and obtained poorer results than those who carried out the directions given them. Four prepared the soil very superficially instead of preparing it to a depth of 25 to 40 centimeters. Their results ranged from 18,700 to 27,000 kg. per hectare, and a starch yield of 4,186 to 5,800 kg. per hectare.

The author believes that the best distance for potato plants is such that the vegetation of each plant can develop freely; but each plant should touch its neighbor and leave no portion of the surface of the ground uncovered. His recommendation is for the rows to be 24 inches apart and the plants 19.3 inches in the drill. To test the proper distance, the author, in 1890 and 1891, conducted experiments in which the rows were uniformly 24 inches apart, and the tubers in the row were planted at distances of 39.5, 19.3, 12, 8, and 5 inches apart. Two varieties were used each year. The following table gives the results:

Yield of potatoes from planting at different distances.

Approximate distance in the rows.	Average yield per hill.	Gross yield per hectare.	Net yield per hectare after deducting potatoes planted.
Variety, Richter Imperator, 1890:	*Kg.*	*Kg.*	*Kg.*
39.5 inches	3.130	31,000	30,000
19.3 inches	1.666	33,300	31,300
12 inches	1.210	39,900	36,600
8 inches	0.880	40,300	35,300
5 inches	0.550	44,600	36,600
Variety, Jenxy, 1890:			
39.5 inches	1.500	16,400	15,400
19.3 inches	0.980	19,600	17,600
12 inches	0.796	26,500	23,200
8 inches	0.500	25,000	20,000
5 inches	0.300	25,030	17,030
Variety, Richter Imperator, 1891:			
39.5 inches	2.210	22,100	21,100
19.3 inches	1.230	24,600	22,600
12 inches	0.941	31,060	27,760
8 inches	0.668	33,400	28,400
5 inches	0.410	32,800	24,800
Variety, Red Skinned, 1891:			
39.5 inches	1.120	11,200	10,200
19.3 inches	0.892	17,840	15,840
12 inches	0.620	20,460	17,160
8 inches	0.410	20,600	15,600
5 inches	0.260	20,800	12,800

The 21 farmers who departed from the recommendations as to distance of plants, but who carried out all other directions faithfully, secured much smaller yields than those who followed directions in this respect. The yields obtained by those who varied the distance from that recommended ranged from 11,800 to 27,000 kg. per hectare.

Those who used less manure than the author directed secured harvests much below the normal. Five who used no manure secured from 12,500 to 28,500 kg. per hectare.

The author is engaged in a more extensive study of the manurial needs of potatoes on different soils. He suggests the use of 600 to

700 kg. of superphosphates, 300 kg. of sulphate of potash, 200 kg. of nitrate of soda, and 25,000 to 30,000 kg. of barn yard manure per hectare (about 11 to 13 tons per acre).

The author's recommendation is to plant whole potatoes of medium size. Those farmers who cut their seed potatoes, but whose crops did not suffer from disease, raised from 12,750 to 28,680 kg. of potatoes per hectare. Fourteen of those who cut their potatoes reported considerable damage from a disease which the author calls gangrene. Only two cases are noted in which this disease affected the crop from whole potatoes.

Nineteen farmers carried on an experiment in planting whole tubers of average size in comparison with cuttings from large tubers. The cuttings and the entire tubers were of the Richter Imperator variety and were all from the same source. The treatment of both plats was the same. The yields diminished as the result of cutting, and the decrease was in proportion to the amount of cutting. The following table gives the detailed results:

Yield of potatoes from whole tubers and from cuttings.

	Yield per hectare from whole tubers.	Yield per hectare from cuttings.		Yield per hectare from whole tubers.	Yield per hectare from cuttings.
	Kg.	*Kg.*		*Kg.*	*Kg.*
Farmer No. 1	32, 000	19, 000	Farmer No. 11	19, 000	12, 500
2	30, 000	24, 800	12	30, 000	20, 000
3	31, 000	21, 300	13	30, 000	25, 600
4	25, 416	18, 572	14	30, 000	25 000
5	22, 466	18, 986	15	36, 250	28, 500
6	26, 690	22, 544	16	27, 500	12, 000
7	34, 700	31, 200	17	25, 000	12, 200
8	41, 580	40, 500	18	33, 625	30, 873
9	33, 250	25, 600	19	41, 910	33, 085
10	33, 000	28, 500			

The yield from the entire seed was in no case less than 19,000 kg. per hectare, while from the cuttings it dropped as low as 12,000 kg.

For two years the author has been conducting in person careful experiments the results of which are also in favor of planting whole tubers of average size. He proposes to continue these experiments for another year before giving to the public the detailed results.

One of the details of the author's method consists in the use of the usual remedies to prevent blight. He observes that Richter Imperator can be placed in the first rank of those varieties capable of resisting potato blight.

In the year 1892 more than 600 farmers undertook these experiments under the direction of the author. Of these the reports from 231 were used in making up the figures of this article. More than half of these obtained upwards of 30,000 kg. per hectare in spite of the prolonged drought of this year, a result far above that obtained by those who did not follow the method recommended by the author. One farmer on 1.5

hectares obtained 49,9'0 kg. of potatoes per hectare, with 19.9 per cent of starch, or about 10,000 kg. of starch per hectare.

In spite of the drought, rational culture gave on poor or medium soils an average of 21,280 kg. of tubers per hectare. The protracted drought gave an opportunity to observe what soils suffered most from dryness. The potato crop suffered much from this cause when the subsoil was permeable, but when the subsoil was impermeable the harvests obtained by the author's cultural methods were exceptionally high.—J. F. D.

Fifteenth technical report of the Federal Seed-Control Station at Zurich for the year ending June 30, 1892, F. G. STEBLER (*Ann. Sci. Agron., 1892, I, No. 2, pp. 217-236*).—During the past year 5,543 samples of seed have been received and tested, an increase of 694 over the previous year, and a threefold increase over the number examined during 1882-'83. In testing these samples of seed for purity, per cent of germinative power, seeds of weeds, genuineness, and quality in general, there have been made 15,387 analyses. Of the number of samples sent to the station for examination 2,553 came from Switzerland and 2,990 from seventeen other countries, giving the station some right to its claim of being an international one.

The station has a contract with seventy-four Swiss seed-growers or wholesale dealers by which it inspects and furnishes a certificate of guaranty for all their seeds. Under the terms of this contract any dealer buying 50 kg. or consumer using 5 kg. of any kind of seed is entitled to a free reinspection of the seed and an attested report of its true value. Under the conditions of this control 1,365 samples of seed, a decrease of 121 from the previous year, were examined, and 189 specimens were found not conforming to the guaranty. One hundred and fifty-two of these samples were lower in real value than guaranteed, 6 contained *Cuscuta* seed; and 31 contained burnet seed.

The greater part of the analyses were made for private individuals, and fees were charged.

An enumeration of all the analyses by species and samples is as follows:

Kind of seed.	Number of species.	Number of samples.
Clovers and leguminous forage plants	17	2,001
Grasses	46	2,693
Perennial forage plants	1	16
Annual forage plants	7	45
Legumes	10	28
Wheat	3	12
Textile plants	2	23
Sugar beets	10	84
Forest seeds	33	676
Other seeds	1	1
Total	130	5,579

From the compiled table of the results of maxima and minima the following species, represented by 100 or more samples, are selected:

Report of seed tests.

Kind of seed.	Number of samples.	Purity.			Germinative ability.		
		Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Red clover	1,009	88.3	99.3	95.7	2	99	88
White clover	115	88.1	98.6	94.2	29	94	77
Alsike clover	149	81.3	99.4	94.3	27	97	78
Lucern	339	53.0	99.4	97.5	64	99	93
Esparcet	226	86.5	99.8	97.9	7	94	75
Oat grass	304	25.4	99.3	79.7	11	91	71
Orchard grass	477	33.3	97.9	80.0	8	98	81
English rye grass	272	43.1	99.8	95.7	38	98	80
Italian rye grass	259	23.9	99.7	95.1	21	94	71
Timothy	124	94.7	99.4	98.3	77	99	92
Crested dog-tail grass	112	68.1	99.4	91.8	11	91	62
Meadow foxtail	130	45.5	95.0	79.9	2	95	65
Meadow fescue	163	62.2	99.7	95.5	3	98	85
Sheep fescue	183	45.6	98.4	76.9	5	91	65
Blue grass	100	50.8	98.4	86.3	17	89	55
Pinus sylvestris	307	84.1	98.9	95.8	0	96	62
Spruce	155	91.0	99.1	96.2	22	92	63
Larch	109	77.1	88.0	83.2	0	43	27

A table of the averages of purity and germinative ability computed from the analyses made from 1876 to 1892 is given, and a comparison of the above table with the averages for sixteen years shows in nearly every case an increased value both in purity and in germinative ability.

The majority of the tests are made during the months of January, February, and March, leaving the working force comparatively free for field tests and other investigations during the summer season.—W. H. E.

Report of the Vienna Seed-Control Station for 1892, T. R. WEINZIERL (*Abs. in Wochenschr. Cent. Ver Rübenz. Ind., 31 (1893), No. 2, pp. 16, 17*).—There were conducted at the station during the past year 2,890 inspections of seed, an increase of 360 over the previous year; and there were sealed and attested 8,030 bags of clover seed, an increase of 2,430 over the previous year. There has been a gradual increase in the number of examinations for which fees are charged, showing an increasing appreciation of the work of the station. Of the 342 tests of seeds for the past year for which fees were charged, 212 were of sugar beets, the rest of turnips, etc.

The normal, or standard, for sugar-beet seed established by the station is as follows: (1) The sample shall not contain more than 3 per cent admixtures; (2) not more than 15 per cent moisture; (3) shall show in six days of the test 125 plants for each 100 seed clusters; (4) shall show in twelve days, the end of the test, not less than 150 well-germinated plants for each 100 seed clusters; (5) shall show not less than 80 per cent germinated seed clusters; (6) each kilogram of seed shall yield not less than 70,000 plants.

The tabulated results of the investigations of the past year are as follows:

	Maximum.	Minimum.	Average.
Per cent of admixtures	11.8	0.6	3.1
Per cent of moisture	21.0	9.8	13.9
Number of grains sprouting per 100 seed clusters	228.0	12.0	160.0
Number of grains sprouting per kilogram of seed clusters	146,200.0	4,740.0	90,200.0
Per cent of seed clusters capable of sprouting	98.0	6.0	83.0

From the above table it will be seen that the average of the tests was in excess of the normal of the station, the per cent of purity only being less than the required amount by 0.1 per cent. The importance of seed control is seen in the increased use of the station by sugar manufacturers and others connected with the sugar-beet industry.—W. H. E.

Character of large and small fat globules in milk, E. GUTZEIT (*Milch Ztg., 22 (1893), No. 27, pp. 439, 440*).—In this preliminary article the author reports studies made in Fleischmann's laboratory to determine whether the large and small fat globules of milk differ from one another in physical and chemical properties. The upper cream layer was removed from a large quantity of milk after twelve hours' setting, and the skim milk run through a separator. The cream and separator skim milk were then examined. They contained 23.5 and 0.12 per cent of fat, respectively. The average volume of the fat globules of the cream was 14.1 μ^3,* and of the skim milk 0.6 μ^3. In color, specific gravity, melting point, index of refraction, volatile fatty acids, saponification equivalent, iodine number, etc., these large and small fat globules were found to agree within the limits of error. The milk from a single cow at one milking was then divided into three portions. The average volume of the fat globules increased as the milking progressed; but in melting point and volatile fatty acids the fat globules in three portions were identical.

The investigation, therefore, fails to recognize any chemical or physical difference between the large and small fat globules of cows' milk.—E. W. A.

The preservation of milk samples with potassium bichromate, ammonia, ammonium nitrate, etc., J. NEUMANN (*Milch Ztg., 22 (1893), No. 28, pp. 453-456*).—The author believes that once a week is often enough to test milk sold at creameries on its fat content. If the herd is a large one and the samples carefully taken, trials made by him indicate that no great injustice will be done to either the producer or the creamery by weekly tests. He suggests that a composite sample be made from these weekly samples and tested at the end of each month, using some kind of preservative in the milk.

As to the value of potassium bichromate as a preservative, it was found that it did not affect the results by either the Babcock, lacto-

* μ^3 = cubic micromillimeter = 0.000,000,001 cubic millimeter.

crite, or Gerber's acid butyrometry method. Milk to which potassium bichromate was added remained sweet from one to two months, and that to which chromic acid was added, about seventeen days. One-half grain of potassium bichromate was sufficient for 2 pounds of milk, and a grain the size of a pin head was enough for 100 c. c. of milk. It is recommended to pulverize the bichromate before adding it to the milk.

If the chromic acid is used 0.5 c. c. of 10 per cent solution is added to 100 c. c. of milk.

It sometimes happens that milk which has commenced to sour can not be preserved from further souring by potassium bichromate. As trouble of this kind was reported by a creamery, the author tried ammonia. In one case 1 c. c. of 27 per cent ammonia was added to 350 c. c. of milk, and in another 15 drops of ammonia to 50 c. c. of milk. By keeping this milk in a cool place where the temperature did not rise above 10° C. (50° F.) it remained sweet for over a month.

Carbonate and bicarbonate of ammonia were tried, but found inferior to ammonia.

Ammonium nitrate, 0.25 gram in 50 c. c. of milk, gave promising results, but its value as a milk preservative was not as thoroughly tested as the other substances. The cream layer mixed readily with the milk when agitated.

Two trials of potassium permanganate solution did not give satisfactory results.

As the use of potassium bichromate as a milk preservative is patented, it is considered desirable that some other preservative equally as good be found for use at creameries.—E. W. A.

Preservation of milk samples with potassium bichromate and potassium permanganate, C. RONNEBERG (*Milch Ztg.*, *22* (*1893*), *No. 28, p. 459*).—Creamery milk was preserved with potassium bichromate from June 13 to June 30.

Potassium permanganate, it is claimed, will prevent the curdling of milk, even if added after the milk has begun to sour. Samples to which 1 gram of permanganate per 250 to 500 c. c. of milk was added had, at the time of writing, been kept eight days, and showed no sign of curdling. The use of permanganate, which was suggested by Dr. Weibull, a Swedish chemist, is not patented.

When milk is paid for at creameries according to the amount of fat furnished, the author favors the testing of composite samples monthly and considers it sufficiently accurate. He uses the Babcock test.—E. W. A.

Potassium permanganate as a milk preservative, KRUEGER (*Molk. Ztg.*, 7 (*1893*), *No. 27, pp. 365, 366, 377, 378*).—Referring to the use of potassium bichromate for preserving milk samples, the author recommends that it be added to the milk in the form of a solution of known strength rather than in crystalline form, on account of the ease in

measuring. When the milk is shaken sufficiently to dissolve the crystals there is danger of partially churning the fat, and when in the Soxhlet test too much bichromate is added, the ether-fat layer separates very difficultly or not at all.

When potassium bicarbonate is added to milk, the milk is colored yellow, but does not change by protracted keeping, except that a layer of fat gradually separates. No odor is emitted, provided the milk was not sour at the outset, and there is no perceptible increase in the germ content of the milk.

When potassium permanganate is used, however, the milk is colored dark brown at first and gradually becomes lighter colored until it is yellow. If the milk is allowed to stand without further addition of permanganate, fermentation soon takes place, and the casein is coagulated. The length of time the permanganate preserves the milk depends upon the amount added. According to tests by the author more permanganate should be added as soon as the milk becomes light brown. If this is followed up milk can be kept for some time. Samples were kept in this way for nineteen days during very warm weather. Tests by the Soxhlet and Babcock tests gave the same results as at the outset, showing that average samples could be taken.

The author concludes from his trials that potassium permanganate is inferior to bichromate as a milk preservative only in that the permanganate must be renewed from time to time, as the color of the milk fades. Its addition to milk does not affect the accuracy of the fat determination by simple methods, but when milk is preserved with it for a long time the separation of the ether-fat layer, in the Soxhlet aërometric test, becomes a very difficult matter. In this respect its effect is similar to bichromate.—E. W. A.

TITLES OF ARTICLES IN RECENT FOREIGN PUBLICATIONS.

CHEMISTRY.

Boracic acid in natural products (*Note sur l'acide borique dans les products naturels*), E. DELTOUR.—*Rev. Internat. Falsif., 19 (1893), No. 9, pp. 157, 158.*

Determination of nitrogen in nitrates, and a new simple modification for the determination of the total nitrogen in mixtures of nitrates with organic and inorganic nitrogenous compounds (*Stickstoffbestimmung in Nitraten, sowie eine neue einfache Modification zur Bestimmung des Gesammtstickstoffs in Gemischen von Nitraten mit organischen und anorganischen Stickstoffverbindungen*), V. SCHENKE.—*Chem. Ztg., 17 (1893), No. 54, pp. 977–979.*

The determination of nitric acid in nitrated fertilizers (*Un mot sur le dosage de l'azote nitrique dans les engrais nitratés*), J. KICKX.—*Rev. Internat. Falsif., 6 (1893), No. 11, pp. 191, 192.*

Volumetric determination of phosphoric acid (*Ueber die volumetrische Bestimmung der phosphate*), C. WAVELET.—*Schweiz. Wochenschr. Pharm., 21, pp. 173, 174; abs. in Chem. Centbl., 1893, II, No. 3, p. 145.*

Volumetric determination of phosphoric acid, A. F. HOLLEMAN.—*Rec. trav. Chim. Pays-Bas, 12, pp. 1–11; abs. in Chem. Centbl., 1893, II, No. 3, p. 147.*

Determination of phosphoric acid in soils, A. CARNOT.—*Bul. Soc. Chim. Paris, 9, pp. 343–346; abs. in Chem. Centbl., 1893, II, No. 3, p. 147.*

Estimation of iron oxide and alumina in mineral phosphates, A. SMETHAM.—*Jour. Soc. Chem. Ind., 1893, p. 112; abs. in Ztschr. angew. Chem., 1893, No. 15, pp. 466–468.*

The direct determination of potash and soda by the "ditartrate" method (*Ueber direkte Bestimmung von Kali und Natron mittels der Ditartrametode*), *Chem. Ztg., 17, (1893), No. 2, pp. 686, 687.*

The furfurol reactions of alkaloids (*Die Furfurol-Reactionen der Alkaloide*), N. WENDER.—*Chem. Ztg., 17 (1893), No. 53, pp. 950, 951.*

Determination of caffein in plants (*Dosage de la caféine dans les végétaux*), A. GRANDVAL and H. LAJOUX.—*Rev. Internat. Falsif., 6 (1893), No. 10, pp. 168–170.*

New method for determining the fat in milk (*Nouvelle méthode pour doser la graisse du lait*), L. LIEBERMANN and S. SZEKELY.—*Rev. Internat. Falsif., 6 (1893), No. 9, p. 156.*

Method of butter analysis (*Méthode generale pour l'analyse des beurres*), R. BRULLÉ—*Ind. Lait., 18 (1893), No. 26, p. 204.*

Pennetier method for determining the presence of margarin in butter, A. PIZZI.—*Staz. Sper. Agr. Ital., 23 (1892), pp. 23-38; abs. in Rev. Internat. Falsif., 6 (1893), No. 11, p. 176.*

A modification of the Reichert-Meissl method for detecting margarin in butter (*Une modification à la méthode Reichert-Meissl pour la recherche de la margarines dans beurre*).—*Rev. Internat. Falsif., 6 (1893), No. 9, p. 157.*

On the increase in temperature by mixing butter and margarin with sulphuric acid, E. HAIRS.—*Jour. Pharm. et Chim., 27 (5), pp. 582-584; abs. Chem. Centbl. 1893, II, No. 3, p. 161.*

Practical methods for analyzing grain (*Méthodes pratiques d'analyses des farines*), LEANDRE.—*Rev. Internat. Falsif., 6 (1893), No. 9, pp. 153-156.*

The Haenle method for examination of honey (*Die Haenle'sche methode zur Untersuchung des Honigs*), A. NEUBURGER.—*Ztschr. Nahr. Untersuch. und Hyg. 7, pp. 163-165; abs. in Chem. Centbl., 1893, II, No. 3, p. 164.*

Methods of analysis of wine, honey, fruit sirups, flour, bread, water, preserved meat, spices, coffee, tea, and cocoa (*Fortschritte auf dem Gebiete des Weines und der Nahrungsmittel*), E. LIST.—*Chem. Ztg., 17 (1893), No. 53, pp. 951-954.*

Action of a ferment in bananas affecting the accurate determination of sugar (*Nochweis fermentativer Processe bei reipen Bananen*), F. MIREAU.—*Chem. Ztg., 17 (1893) No. 55, p. 1002 and No. 56, pp. 1021, 1022.*

A thermostat for temperatures between 50° and 300° (*Ein Thermostat für Temperaturen zwischen 50 und 300 Grad.*), A. MEHLKE.—*Ztschr. Instrumentenkunde, 13, pp. 197-200; abs. in Chem. Centbl., 1893, II, No. 3, pp. 129, 130, fig. 1.*

A new modification of the Soxhlet extractor (*Di una nuova modificazione all Apparechie estrattore di Soxhlet*), L. CARCANO.—*Staz. Sper. Agri. Ital., 24 (1893), pp. 234, 235; abs. in Chem. Centbl., 1893, II, No. 3, p. 129, fig. 1.*

Studies on the chemical analysis and microscopic examination of flour (*Étude sur l'analyse et l'examen microscopique des farines*), L. DELAYE.—*Rev. Internat. Falsif., 6 (1893), No. 10, pp. 173-175.*

A safe distilling apparatus, especially for use in the Kjeldahl method (*Ein zuverlässiger Destillierapparat*), M. MÜLLER.—*Ztschr. angew. Chem., 1893, No. 8, pp. 229, 230; and Chem. Centbl., 1893, II, No. 1, p. 3, fig. 1.*

An apparatus for measuring out the ether and potassium hydrate used in the Soxhlet aërometric method(*Ein Hilfsapparat zum Abmessen von wasserhaltigem Aether und Kalilange für der Soxhlet'schen araometrischen. Apparat zur Fettbestimmung in der Milch*), ALBERT.—*Milch Ztg., 22 (1893), No. 28, pp. 461, 462, figs. 3.*

BOTANY.

Krugia, a new genus of Myrtaceæ (*Krugia, eine neue Myrtaceengattung*), I. URBAN.—*Ber. deut. Bot. Ges., II (1893), No. 6, pp. 375, 376.*

Pleurostichidium, a new genus of Rhodomeleæ (*Pleurostichidium, ein neues Genus der Rhodomaleen*), F. HEYDRICH.—*Ber. deut. Bot. Ges., II (1893), No. 6, pp. 344-348, figs. 10.*

The anatomy of the Acanthaceous genera, Afromendoncia and Mendoncia (*Ueber die Anatomie der Acanthaceengattungen Afromendoncia und Mendoncia*), E. GILG. —*Ber. deut. Bot. Ges., II (1893), No. 6, pp. 351–363, figs. 5.*

The characteristic of citrate of lime and an investigation concerning the disposition of citric acid in metabolism (*Zur Charakteristik des citronensäuren Kalkes und einige Bemerkungen über die Stellung der Citronensäure im Stoffwechsel*), C. WEHMER.—*Ber. deut. Bot. Ges., II (1893), pp. 333–343, figs. 10.*

A contribution to the chemistry and physiology of foliage leaves, H. T. BROWN and G. H. MORRIS.—*Ann. Bot., 7, No. 26, pp. 271–289.*

Occurrence of cyanic acid in plants, P. VAN ROMBURGH.—*Rec. trav. Chim. Pays-Bas, 12, p. 50; abs. in Chem. Centbl., 1893, II, No. 2, p. 93.*

The influence of the magnesium light on the development of plants (*Sopra l'azione della luce de magnesio sullo sviluppo dei vegetali*), G. TOLOMEI.—*Staz. Sper. Agr. Ital., 24 (1893), No. 4, pp. 377–386; abs. in Chem. Ztg., 17 (1893), No. 52, Repert. p. 180.*

Electroculture of plants (part II) (*Elektrische Kulturversuche*), E. WOLLNY.—*Forsch. Geb. agr. Phys., 16 (1893), No. 3 and 4, pp. 243–267.*

BACTERIOLOGY AND FERMENTATION.

The probable destruction of bacteria in polluted river water by infusoria, D. H. ATTFIELD.—*British Med. Jour., June, 1893; and Chem. News 68 (1893), No. 1756, pp. 35, 36.*

Vegetable ferments, J. R. GREEN.—*Ann. Bot., 7, No. 25, pp. 83–137.*

The fermentations of the banana, D. ACOSTA.—*Cronica médica quirurgica de la Habana, 1892, No. 10; abs. in Staz. Sper. Agr Ital., 24 (1893), No. 4, p. 431.*

SOILS

The influence of the mechanical treatment of the soil and of covering the soil with moss on the growth of the pine (*Untersuchungen über den Einfluss der mechanischen Bodenbearbeitung und der Bedeckung des Bodens mit Moos auf das Wachstum der Fichtenpflanzen*), A. CIESLAR.—*Centbl. Ges. Forstwesen Wein, 1893; abs. in Forsch. Geb. agr. Phys., 16 (1893), No. 3 and 4, pp. 232–237.*

Investigations concerning the permeability of the soil to air (*Untersuchungen über die Permeabilität des Bodens für Luft*), E. WOLLNY.—*Forch. Geb. agr. Phys., 16 (1893), No. 3 and 4, pp. 193–222.*

FERTILIZERS.

Contributions to the study of the nitrogen feeding of plants (*Contribution à l'étude de l'alimentation azotée dés végétaux*), E. BREAL.—*Ann. Agron., 19, (1893), No. 6, pp. 275–293.*

The lupine as a plant for green manuring (*Die lupine als Gründüngungspflanze*), J. KÜHN.—*Wiener Landw. Ztg. 43 (1893), No. 46, pp. 379, 380.*

History of potash fertilizer manufacture in Stassfurt (*Zur Geschichte der Kalidüngerfabrikation in Stassfurt*), A FRANK.—*Ztschr. angew. Chem., 1893, No. 11, pp. 325, 326.*

FIELD CROPS.

Cotton culture in central Asia (*Die Lage der Baumwolle-Cultur in Central-Asien*), H. NEUMARK.—*Chem. Ztg., 17 (1893), No. 55, pp. 1000, 1001, and No. 57, pp. 1031, 1032.*

American ginseng.—*Kew Misc. Bul. No. 76 and 77, pp. 71–75.*

Hop culture, C. WHITEHEAD.—*Jour. Roy. Agr. Soc. England, 4 (1893), No. 14, pp. 217–262.*

Polygonum sachalinense (*La Sacaline*), E. ANDRÉ.—*Rev. Hort., 65 (1893), No. 14, pp. 326, 327; No. 17, p. 393.*

An inquiry as to the richness in starch of different varieties of potatoes (*Enquête sur la richesse en fecule des diverses variétiés de pomme de terre*), A. PETERMANN —*Ann. Sci. Agron., 1892, I, No. 2, pp. 179–213.*

Experiments with varieties of potatoes (*Expériences sur quelques variétés de pomme de terre*), M. ZACHAREWICZ.—*Ann. Agron., 19 (1893), No. 4, pp. 190–196.*

The prickley comfrey of the Caucasus (*La consoude regueuse du Caucase*), G. LECHARTIER.—*Ann. Agron., 19 (1893), No. 6, pp. 257–273.*

Sugar-beet culture on farms where stock is not kept (*Viehlose Wirthschaft mit Beziehung auf Zuckerindustrie*), A. PROSKOWETZ.—*Oestrr. ungar. Ztschr. Zuckerind. und Landw, 1893, No. 1, pp. 1–14.*

The loss of sugar in sugar beets during storage (*Der Zuckerverlust bei eingemietheten Fabriksrüben und bei Samenrüben*), H. BRIEM.—*Wochenschr. Cent. Ver. Rübenz. Ind., 31 (1893), No. 28, pp. 440, 441.*

Results of a three-years' experiment in growing wheat in rotation with clover (*Risultato finale delle esperienze triennali di coltivazione del frumento collegate con la coltura del trifoglio pratense nelle provincie di Forli e Ravenna*), A. PASQUALINI and A. SINTONI.—*Staz. Sper. Agr. Ital., 24 (1893), No.4, pp. 338–356.*

Tagasaste, a new fodder plant.—*Kew Misc. Bul. No. 78, pp. 115–117.*

The culture of wheat (*Die Kultur der Wiesen*), F. KÖNIG.—*Mitt. deut. landw. Ges., 1893–94, No. 1, pp. 1–7.*

Wormwood (Artemisia maritima) as a fodder plant in India.—*Kew Misc. Bul. No. 78, pp. 126–128.*

Culture of catch crops in autumn (*Sur les cultures dérobées d'automne*), P. P. DEHÉRAIN.—*Ann. Agron., 19 (1893), No. 7, pp. 305–338.*

HORTICULTURE.

The forcing of lettuce (*Culture forcée de la laitue*), G. ALLUARD.—*Rev. Hort., 65 (1893), No. 14, pp. 331–333.*

Investigations on the vineyards of Champagne (*Recherches sur les vignobles de la Champagne*), A. MÜNTZ.—*Bul. Min. Agr. France, 12 (1893), No. 2, pp. 170–209.*

Horticulture in Belgium.—*Kew Misc. Bul. No. 79, pp. 162–167.*

FORESTRY.

The best varieties of willows (*Empfehlenswerthe Weidensorten*).—*Fühling's landw. Ztg., 42 (1893), No. 15, p. 509.*

The fuel value of different woods (*Heizwerthe der einzelnen Holzsorten*).—*Fühling's landw. Ztg., 42 (1893), No. 15, p. 512.*

SEEDS.

The relation of the sprouting seed to water in general and especially to soil moisture (*Über das Verhalten der keimenden Samen zum Wasser in allgemeinen und speziell zur Bodenfeuchtigkeit*), S. BOGDANOFF.—*Landw. Vers. Stat., 42, No. 3–5, pp. 311–366.*

Germination tests (*Keimungsfähigkeit und Keimungsenergie*).—*Fühling's landw. Ztg., 42 (1893), No. 15, pp. 508, 509.*

Annual Report of the seed-control station of the National Agricultural Institute of France for 1891–'92 (*Rapport général annuel sur les travaux de la station d'essais de semences de l'Institut National Agronomique en 1891–1892*), SCHRIBAUX.—*Bul. Min. Agr. France, 12 (1893), No. 3, pp. 241–253.*

ENTOMOLOGY.

Experiments in combating Cochylis ambiguella on the vine (*Esperienze intorno ai mezzi atti a combattere il bruco della vite*), M. ZECCHINI and E. SILVA.—*Staz. Sper. Agr. Ital., 24 (1893), No. 4, pp. 357–376.*

FOODS.

Cotton-seed meal and cotton-seed cake (*Über Baumwollsaatmehl und Baumwollsamenkuchen*), GEBEK.—*Landw. Vers. Stat., 42, No. 3–5, pp. 279–309.*

Leafy twigs as a feed stuff (*Zur Linderung der Futternot*), M. NEUMEISTER.—*Deut. landw. Presse, 20 (1893), No. 50, pp. 537, 538.*

Bacteriological and chemical studies on the white of the egg (*Bacteriologische und chemische Studien über das Hühnereiweiss*), H. SCHOLL.—*Arch. Hyg., 17, pp. 535–551.*

Vinegar, A. H. ALLEN and C. G. MOOR.—*Chemist and Druggist; abs. in Analyst, 18 (1893), July, pp. 180–183.*

Investigations on the adulteration of butter (*Recherches de la falsification du beurre*), A. HOUZEAU.—*Rev. Internat. Falsif., 6 (1893), No. 10, pp. 171–173.*

The sophistication of olive oil (*Ricerche sulla sofisticazione dell' olio d'oliva*), V. OLIVERI.—*Staz. Sper. Agr. Ital., 24 (1893), No. 4, pp. 387–397.*

ANIMAL PRODUCTION.

The breeding of cattle and the characteristics of the European breeds (*Mittheilungen aus dem Gebiete der Rindviehzucht*), LEHMERT.—*Fühling's landw. Ztg., 42 (1893), No. 15, pp. 495–503.*

Fattening calves (*Die Kälbermost*), H. HEINE.—*Deut. landw. Presse, 20 (1893), No. 35, pp. 379, 380.*

ANIMAL PHYSIOLOGY AND DISEASES.

The albuminoid conserving power of fat (*Die eiweissersparende Kraft des Fettes*), VON NOORDEN and KAYSER.—*Du Bois-Raymond's Arch. Anat. und Physiol., 1893, pp. 371–373; abs. in Chem. Centbl., 1893, II, No. 2, pp. 97, 98.*

Formation of carbohydrates in the animal body during hunger (*Neubildung von Kohlenhydraten im hungernden Organismus*), N. ZUNTZ and VOGELIUS.—*Du Bois-Raymond's Arch. Anat. und Physiol., 1893, pp. 378–380; abs. in Chem. Centbl., 1893, II, No. 2, p. 100.*

Sickness of cattle caused by feeding fermented beet diffusion residue, and potato pulp, C. CORNEVIN (*Bul. de Assoc. Chim., No. 9 (1893), p. 630; abs. in Oesterr. ungar. Ztschr. Zuckerind. und Landw., 22, (1893), No. 2, pp. 324, 325.*

DAIRYING.

The separation of fat in sterilized milk (*Ueber Fettausscheidung aus sterilisirter Milch*), RENK.—*Arch. Hyg. 17, pp. 312–323.*

Influence of odors on the quality of milk (*Influence des odeurs sur la qualité du lait*).—*Rev. Internat. Falsif., 6 (1893), No. 11, p. 199.*

Influence of food on the quality of milk (*Recherche sur l'influence de l'alimentation sur la richesse du lait*), P. GAY.—*Ann. Agron., 19 (1893), No. 10, pp. 293–302.*

The germ content of the market milk of Dorpat, Russia, and bacteriological examinations of human milk (*Ueber den Keimgehalt der Dorpate Marktmilch nebst einigen bakteriologischen Untersuchungen von Frauenmilch*), H. KNOCHENSTIERN.—*Diss. Dorpat, 1893; abs. in Chem. Centbl., 1893, II, No. 1, p. 62.*

Vegetable rennet ferment (*Pflanzliches Labferment*), J. R. GREEN.—*Bot. Centbl., 1893, II, No. 2, p. 86.*

Contributions to the investigation of the ripening of cheese (*Beiträge zur Erforschung der Käsereifung*), F. BAUMANN.—*Landw. Vers. Stat., 42, No. 3–5, pp. 181–214, plate 1.*

TECHNOLOGY.

The occurrence of copper in the products of sugar manufacture (*Ueber das Vorkommen des Kupfers in den Producten der Zuckerfabrikation*), DONATH.—*Oesterr. ungar. Ztchr. Zuckerind und Landw., 1893, 2, No. 2, pp. 236–239.*

The mesh of hops (*La marc de houblon*), G. DE MARNEFFE.—*Ann. Sci. Agron., 1892, I, No. 2, pp. 214, 215.*

Utilization of the residuum from wine-making (*Utilisation des marc de vendange*), DEHÉRAIN.—*Abs. in Chron. Agr. Cant. Vaud, 1893, No. 7. p. 278.*

Residues from the manufacture of volatile oils (*Rückstände der Fabrikation ätherischer Öle*), P. UHLITZSCH.—*Landw. Vers. Stat., 42, No. 3–5, pp. 215–277, plates 4.*

Gambier, a tannin plant of Borneo.—*Kew Misc. Bul. No. 78, pp. 139–141.*

Wiecher's fiber-extracting machine.—*Kew Misc. Bul. No. 78, p. 141–144.*

Manila aloe fiber.—*Kew Misc. Bul. No. 77, pp. 78–80.*

AGRICULTURAL ENGINEERING.

An experiment in subterranean irrigation and a statement of the theory of a proposed system for such irrigation (*Irrigazione sotterranea—Relazione di un esperimento eseguito e teoria del sistema proposto*), G. TORRICELLI.—*Staz. Sper. Agr. Ital., 24 (1893), No. 5, pp. 451–513.*

A universal plow (*Die Sack'schen Pflüge*).—*Schweiz. Landw. Ztschr., 21 (1893), No. 29, pp. 467–469, figs. 54.*

Dynamometer tests of plows (*Bericht uber des Probepflügen*), HENSOLT.—*Landbote 14 (1893), No. 55, pp. 553–555.*

A new stacking contrivance (*Ein neuer Tristenhauer*).—*Weiner landw. Ztg. 43, (1893), No. 46, p. 379.*

Report of the station for testing farm implements at Paris (*Rapport sur les experiences effectuées à la station d'essais de machines*), RINGELMANN.—*Bul. Min.. Agr. France, 12 (1893), No. 2, pp. 127–169.*

STATISTICS.

Report of the Darmstadt Experiment Station for 1892 (*Bericht über die Thatigkeit de landwirthschaftlichen Versuchsstation Darmstadt fur des Jahr 1892*), P. WAGNER.—*Ztschr. landw. Ver. Hessen, 1893, No. 25, pp. 202, 203, and No. 26, pp. 210–212.*

Report of the Königsberg Experiment Station (*Ueber die Thätigkeit der Königsberger landwirthschaftlichen Versuchsstation*), G. KLIEN.—*Königsberger landw. und forstw. Ztg. 1893, No. 26, pp. 175, 176.*

The practical school of arboriculture of Paris, (*L'école pratique d'arboriculture de la Ville de Paris*), S. MOTTET.—*Rev. Hort., 65 (1893), No. 14, pp. 329–331.*

EXPERIMENT STATION NOTES.

ALABAMA CANEBRAKE STATION.—H. Benton has been elected assistant director in charge, *vice* B. M. Duggar. J. A. Stuart has become veterinarian of the station.

CALIFORNIA COLLEGE.—The *Occident* of September 1, published at the University of California, contains an illustrated description of the greenhouses to be erected at the University at a cost of $20,000. The new greenhouses will have an extreme length of 170 feet, and the total interior area will be upward of 7,000 square feet.

COLORADO COLLEGE AND STATION.—Alston Ellis, LL. D., president of the college, has been made director of the station; W. P. Headden has become chemist of the station, *vice* D. O'Brine, D. Sc.; D .W. Working, B. S., secretary, *vice* F. J. Annis, M. S.; M. J. Huffington, assistant horticulturist; J. H. McClelland, superintendent of Divide Substation at Table Rock, *vice* G. F. Breninger.

KENTUCKY STATION.—A. T. Jordan has become assistant horticulturist of the station.

MICHIGAN COLLEGE AND STATION.—L. G. Gorton, of Detroit, has been elected president of the college and director of the station, *vice* O. Clute, LL. D., who has accepted a similar position in Florida. Clinton D. Smith, formerly director of the Minnesota Station, has become professor of agriculture in the Michigan College, *vice* P. M. Harwood. F. B. Mumford, B. S., has been made assistant professor of agriculture.

NEBRASKA STATION.—A. M. Troyer, B. S., has been elected assistant agriculturist. G. B. Frankforter, PH. D., has been elected chemist of the station. The pathobiological laboratory has been removed to a building recently erected on the University farm. The University farm, with all its stock, implements, etc., has been turned over to the station for experimental purposes.

NEW YORK CORNELL UNIVERSITY.—Work has been begun on a new building for instruction in dairy husbandry. It will be a stone structure, 45 by 90 feet, two stories high, and will accommodate sixty students.

NORTH CAROLINA STATION.—The plan inaugurated by the station in furnishing plate matter to the various papers in this State has been pursued with much success for several months past. This matter embraces special reports on the work in progress at the station and completed, as well as timely suggestions to farmers in their operations. An important part of the plan is in the publication of "Questions and Replies" of general interest. These questions are encouraged and cover every branch of farming. Three columns are prepared once each month, and the newspapers of the State gladly avail themselves of the opportunity of printing them.

TENNESSEE STATION.—At a meeting of the board of trustees of the University of Tennessee, Agricultural and Mechanical College, upon the recommendation of the board of control of the Agricultural Experiment Station, the organization of this department was modified as follows :

The name of the executive committee of the trustees, heretofore called the board of control, was exchanged to experiment station committee. In conjunction with the president this committe will direct all the operations of the station and the farm. The office and title of director of the station was abolished and the title of assistant director was changed to secretary. The president of the university is the head of this department, as of other departments of the institution, recommending appropriations, approving warrants, and fixing the work of each person on the staff, in accordance with the directions of the experiment station committee. The secre-

tary is the executive officer for this special department and keeps all books, attends to the correspondence, and performs all the other duties hitherto performed by the director. The experiment station committee, heretofore the board of control, is as follows: M. P. Jarnagin, chairman; H. G. Kyle, O. P. Temple, J. W. Allison, and W. H. Jackson.

The staff of the station is, from the first of July, 1893, as follows: C. W. Dabney, Jr., PH. D., LL. D., president; C. F. Vanderford, secretary and agriculturist; F. Lamson-Scribner, B. S., botanist; S. M. Bain, B. A., assistant botanist; R. L. Watts, B. AGR., horticulturist; the president in charge of the chemical division; J. B. McBryde, C. E., assistant chemist; C. A. Mooers, B. S., assistant in fertilizer work; C. E. Chambliss, B. S., assistant in entomology; T. F. Peck, foreman of farm.

UTAH STATION.—W. P. Cutter, B. S., has resigned his position as chemist of the station to become librarian of the United States Department of Agriculture.

VERMONT STATION.—J. L. Hills, B. S., has been appointed director of the station, *vice* W. W. Cooke, M. A., who has become professor of agriculture in the Colorado Agricultural College and agriculturist of the Colorado Station.

WASHINGTON COLLEGE and STATION.—Elton Fulmer has entered upon his work as professor of chemistry and chemist of the station.

WEST VIRGINIA.—The article on pruning published in Bulletin No. 27, and credited in Experiment Station Record, vol. IV, p. 728, to C. Becker, should have been credited to F. W. Rane.

QUEENSLAND.—Bulletin No. 23 of the Department of Agriculture, Brisbane, is an illustrated manual on sericulture.

ONTARIO.—The annual report of the Farmers' Institute held in Ontario during 1892 includes a considerable number of select addresses on a variety of practical topics.

GREAT BRITAIN.—Major Craigie, of the board of agriculture, is making a tour in this country to study our system of agricultural education and investigation.

The following is a summary of the agricultural returns of Great Britain for 1893, as compared with 1891 and 1892:

Acreage of land in Great Britain devoted to different crops.

Year.	Wheat.	Barley.	Oats.	Potatoes.	Hops.
1891	2, 307, 277	2, 112, 798	2, 899, 129	532, 794	56, 142
1892	2, 219, 838	2, 036, 810	2, 997, 545	525, 361	56, 259
1893	1, 897, 488	2, 076. 097	3, 171, 756	527, 821	57, 576

Number of cattle, sheep, and pigs in Great Britain.

Year.	Cattle.				Sheep and lambs.			Pigs.
	Cows and heifers in milk or in calf.	Two years old and above.	Under 2 years old.	Total.	Sheep.	Lambs.	Total.	
1891	2. 657, 054	1, 504, 649	2, 691, 118	6, 852, 821	17, 786, 941	10, 945, 617	28, 732, 558	2, 888, 773
1892	2, 650, 891	1, 666, 706	2, 627, 186	6, 944, 783	17, 957, 049	10, 777, 655	28, 734. 704	2, 137. 859
1893	2, 554, 624	1, 580, 242	2, 565, 810	6, 700, 676	17, 039, 739	10, 240, 595	27, 280, 334	2, 113, 530

HOHENHEIM ACADEMY—The *Deut. landw. Presse,* 1893, No. 45, gives the number of students who have attended the agricultural academy of Hohenheim in the seventy-five years of its existence as 5,250. Of these 1,338 were from other countries than Germany.

POMMRITZ STATION.—Dr. P. Bretschneider, director of the experiment station at Pommritz, Saxony, resigned July 1. His place has been filled by Dr. G. Loges, former director of the station at Posen, Prussia.

CONSULAR REPORTS.—Report No. 152, May, 1893, contains articles on sugar beets in Germany, jute and other fibers in Belgium, Argentine Republic, and the Bahamas, and banana culture in Honduras; No. 153, June, 1893, on the castor bean in India; and No. 154, July, 1893, on flax culture.

THE TANNOIDS.—A bibliography of the tannoids, from the standpoint of vegetable physiology, prepared by J. Christian Bay, has been issued as advance sheets of the fifth annual report of the Missouri Botanical Garden.

WATER-CONTENT OF BUTTER.—The Prussian minister of agriculture has requested the agricultural experiment stations to make extensive studies on the percentage of water in butter at different seasons of the year, with a view to fixing a maximum for the water-content of butter. Dr. Weigmann, of the Kiel station, will take an active part in the investigation.

NAHM MILK-TESTER.—The fat is freed by heating milk in a water bath, with alcoholic potash solution and amyl alcohol. The heating is done in a bulb, the lower part of which is of rubber or some elastic material, and the upper part of glass, terminating above in a graduated stem and a rubber tube with mouthpiece. After the heating, the solution is sucked up into the graduated tube by means of the rubber tube, the rubber bottom of the bulb making this practicable. The tube is then closed with a stop-cock, and the fat read off. The method is covered by a German patent.

HOP CULTURE.—In an article contributed to the Journal of the Royal Agricultural Society of England, Mr. Charles Whitehead gives a history of hop cultivation in England, notes on varieties of hops, and full directions for growing and drying the crop.

Although the acreage in hops in England was in 1892 only 56,259 acres, this crop is there of much importance, since hops usually command a high price. The prices are subject to great fluctuation ranging from about 12 cents to a dollar per pound, the average being about 34 cents. The average crop is reckoned at 700 pounds per acre, and the average cost per acre is about $170.

Of the 229,895 acres of hops in the world, America has 55,000 acres. The world's annual consumption of hops is estimated at 156,600,000 pounds for 1892.

SUGAR CANE.—Bulletin No. 8 of the Calumet Plantation in Louisiana, by the chemist, Huber Edson, gives the results of experiments with sugar cane grown in 1890, 1891, and 1892. Experiments with varieties resulted in the retention for future experiments of the Tibbo Merd, Pupuha, and Uwala, as being the best of the foreign varieties tested.

Experiments on the relative advantages of using for seed the canes grown from stubble and from plant cane gave contradictory results.

The leading topic of this bulletin is the improvement of sugar cane. The results of valuable experiments are given and discussed at length. From the crop of 1891 two lots of cane were selected. One lot consisted of the best canes, especially rich in sucrose and of high purity; the other comprised only those canes whose sugar content and purity were especially low. These two lots were planted and the resulting crop showed a difference of 0.3 per cent sucrose and 2.1 per cent purity in favor of the richer seed cane. Similar selections made the next season, were planted and gave an excess of 0.8 per cent sucrose and 2.3 per cent purity in favor of the richer seed cane.

Unselected cane from the plant which had been planted with rich seed cane and from the plant on which poor seed cane had been used, were planted for comparison. The crop from the former was richer in sucrose by 0.9 per cent and higher in purity by 3.3 per cent than the crop which traced back to the poorer ancestor.

The experiments will be continued and will be so extended as to note the effect of selection not only on the first crop of plant cane, but also on succeeding crops of stubble cane.

LIST OF PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE.

JUNE AND JULY, 1893.

Report No. 5.—A Report on the Leaf Fibers of the United States.

Studies of Parasitic and Predaceous Insects in New Zealand, Australia, and Adjacent Islands.

DIVISION OF CHEMISTRY:

Farmers' Bulletin No. 12.—Nostrums for Increasing the Yield of Butter.

DIVISION OF ENTOMOLOGY:

Bulletin No. 30.—Reports of Observations and Experiments in the Practical Work of the Division.

DIVISION OF FORESTRY:

Bulletin No. 7.—Forest Influences.

Bulletin No. 8.—Timber Physics, part II. Results of Investigations on Long-Leaf-Pine.

OFFICE OF EXPERIMENT STATIONS:

Experiment Station Record, vol. IV, No. 8.

Bulletin No. 13.—Organization Lists of the Agricultural Experiment Stations and Agricultural Schools and Colleges in the United States.

Bulletin No. 14.—Proceedings of a Convention of the National League for Good Roads.

Farmers' Bulletin No. 11.—The Rape Plant: Its History, Culture, and Uses.

DIVISION OF STATISTICS:

Report No. 105 (new series) May, 1893.—Report of the Statistician.

Report No. 106 (new series) June, 1893.—Report of the Statistician.

DIVISION OF VEGETABLE PATHOLOGY:

Journal of Mycology, vol. VII, No. 3.

Bulletin No. 4.—Experiments with Fertilizers for the Prevention and Cure of Peach Yellows

WEATHER BUREAU:

Monthly Weather Review, April, 1893.

Monthly Weather Review, May, 1893.

Bulletin No. 9.—Report on the Forecasting of Thunderstorms during the Summer of 1892.

DIVISION OF BOTANY:

Contributions from the U. S. National Herbarium, vol. I, No. 7—July 15, 1893.—Systematic and Alphabetical Index to new Species of North American Phanerogams and Pteridophytes published in 1892.

LIST OF STATION PUBLICATIONS RECEIVED BY THE OFFICE OF EXPERIMENT STATIONS.

JUNE AND JULY, 1893.

Agricultural Experiment Station of the Agricultural and Mechanical College of Alabama:

Bulletin No. 43, May, 1893.—Eye Diseases of Domestic Animals.

Bulletin No. 44, May, 1893.—Tobacco Plant.

Bulletin No. 45, June, 1893.—Injurious and Beneficial Insects.

Bulletin No. 46, June, 1893.—Rye *vs.* Ensilage.

Bulletin No. 47, July, 1893.—Fruits.

Arkansas Agricultural Experiment Station:

Bulletin No. 23, March, 1893.—Cotton.

Agricultural Experiment Station of the University of California:

Bulletin No. 102, June 22, 1893.—Analyses of Figs and Fig Soils.

Agricultural Experiment Station of the University of Idaho:

Bulletin No. 3, March, 1893.—The Application of Chemistry to the Agricultural Development of Idaho.

Agricultural Experiment Station of Indiana:

Bulletin No. 44, May, 1893.—Dairy Experiments.

Iowa Agricultural Experiment Station:

Bulletin No. 20, February, 1893.—Steer Feeding; Sugar Beets in Iowa, 1892; Machinery and Methods of Spraying; Grass and Leaf Hoppers; Treatment of Fungus Diseases, 1892; Treatment of Spot Diseases of the Cherry and Currant and Potato Blight; Prevention of Corn and Oat Smut; Experiments with Mallein; Rainfall Record.

Louisiana Agricultural Experiment Stations:

Bulletin No. 22.—Results of the Year 1892.

Special Bulletin.—The Orange and Other Citrus Fruits.

Maryland Agricultural Experiment Station:

Bulletin No. 20, March, 1893.—The Composition and Digestibility of the Different Parts of Corn Fodder.

Special Bulletin K, June, 1893.—Composition of Commercial Fertilizers Sold in the State.

Massachusetts State Agricultural Experiment Station:

Bulletin No. 47, May, 1893.—Meteorological Summary, January, February, March, and April, 1892-'93.

Analyses of Commercial Fertilizers, May, 1893.

Bulletin No. 48, June, 1893.—Meteorological Summary, May and June, 1892-'93.

Hatch Experiment Station of the Massachusetts Agricultural College:

Meteorological Bulletin No. 54, June, 1893.

Experiment Station of Michigan Agricultural College:

Bulletin No. 94, April, 1893.—Birds of Michigan.

Bulletin No. 95, April, 1893.—Potatoes.

Agricultural Experiment Station of the University of Minnesota:

Bulletin No. 28, March, 1893.—The Classification of Insects and their Relation to Agriculture.

MISSISSIPPI AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 25, June, 1893.—Colic in Horses and Mules.

NEW HAMPSHIRE AGRICULTURAL EXPERIMENT STATION:

Third and Fourth Annual Reports, 1890 and 1891.

NEW JERSEY AGRICULTURAL EXPERIMENT STATIONS:

Bulletin No. 93, July 1, 1893.—Analyses and Study of Home-Mixed Fertilizers and Fertilizing Materials.

NEW YORK AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 54 (new series), May, 1893.—Experiments in the Manufacture of Cheese.

Bulletin No. 55 (new series), May, 1893.—General Principles Relating to the Composition and Use of Fertilizers.

CORNELL UNIVERSITY AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 52, May, 1893.—Cost of Milk Production; Variation in Individual Cows.

Bulletin No. 53, May, 1893.—Œdema of the Tomato.

NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION

Fifteenth Annual Report, 1892.

Sixth Annual Report of the Meteorological Division, 1892.

Bulletin No. 89*a*, March 18, 1893.—Fertilizer Analyses.

Bulletin No. 90*a*, April, 1893. Results of Chemical Analyses of Tobacco Cured by the Leaf-cure on Wire and the Stalk Process.

Bulletin No. 90*b*, April, 1893.—Chemical Analyses of some Native North Carolina Grasses, Forage Plants, Grains, Seeds, and By-products.

Bulletin No. 91, April, 1893.—Some Experiments in Wheat Culture; Thunder Storm Observations in North Carolina, June 1 to August 31, 1893.

Bulletin No 91*a*, May, 1893.—Meteorological Summary for North Carolina for April, 1893.

Bulletin No. 90*c*, April 19, 1893.—Fertilizer Analyses.

Bulletin No. 91*b*, June 19, 1893.—Fertilizer Analyses.

Bulletin No. 91*c*, June 20, 1893.—Meteorological Summary for North Carolina, May, 1893; The Oxford Tornado of May 3, 1893.

OREGON AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 26, May, 1893.—Drainage.

THE PENNSYLVANIA STATE COLLEGE AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 23, April, 1898.—Forest Fires; Experience with Evergreens in Pennsylvania.

SOUTH DAKOTA AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 33, February, 1893.—Some Plants Injurious to Stock.

Bulletin No. 34, April, 1893.—The Sugar Beet.

Bulletin No. 35, May, 1893.—Fungus Diseases and Insect Pests.

TENNESSEE AGRICULTURAL EXPERIMENT STATION:

Third Annual Report, 1890.

Fourth Annual Report, 1891.

Fifth Annual Report, 1892.

TEXAS AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 26, March, 1893.—Cost of Cotton Production and Profit per Acre.

AGRICULTURAL EXPERIMENT STATION OF UTAH:

Bulletin No. 22, May, 1893.—Grass *vs.* Non-Grass Fed Pigs; Exercise *vs.* Non-Exercise of Pigs; Value of Natural Waters for Crop Growth.

VERMONT STATE AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 31, February, 1893.—Feeding Tests with Sugar Meal, Cream Gluten Meal, and Germ Food.

Bulletin No. 33, April, 1893.—Record of the Station Herd for the Year 1892.

Bulletin No. 34, April, 1893.—Analyses of Fertilizers Licensed for Sale in the State during 1893.

VERMONT STATE AGRICULTURAL EXPERIMENT STATION—Continued.

Bulletin No. 35, May, 1893.—Analyses of Fertilizers Licensed for Sale in the State of Vermont in the Year 1893.

WASHINGTON AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 6, October, 1892.—Horticultural Information.

WEST VIRGINIA AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 31, April, 1893.—Catalogue of West Virginia *Scolytidæ* and their Enemies.

AGRICULTURAL EXPERIMENT STATION OF THE UNIVERSITY OF WISCONSIN:

Bulletin No. 36, July, 1893.—Directions for Using the Babcock Milk Test and the Lactometer.

WYOMING AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 13, July 1893.—The Feeding and Management of Cattle.

DOMINION OF CANADA.

ONTARIO AGRICULTURAL COLLEGE EXPERIMENT STATION:

Bulletin No. 89, May, 1893.—Analysis of Fodder Corn.

BUREAU OF INDUSTRIES, TORONTO, ONTARIO:

Bulletin No. 45, June, 1893.—Crops and Live Stock in Ontario.

PUBLICATIONS OF THE OFFICE OF EXPERIMENT STATIONS.

The Office of Experiment Stations issues three classes of publications for general distribution:

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The following publications have been issued:

Experiment Station Record, vol. I, 6 numbers; vol. II, 12 numbers; vol. III, 12 numbers and index; vol. IV, 12 numbers, including index; vol. V, Nos. 1 and 2. Copies of the station and Department publications abstracted in the Record can, in many instances, be obtained on application.

Bulletins.—No. 1, Organization and History of the Stations; No. 2, Digest of Annual Reports of the Stations for 1888, in two parts; No. 3, Report of Meeting of Horticulturists at Columbus, Ohio, June, 1889; No. 4, List of Station Horticulturists and Outline of their Work; No. 5, Organization Lists of Stations and Colleges, March, 1890; No. 6, List of Station Botanists and Outline of their Work; No. 7, Proceedings of the Fifth Annual Convention of the Association of American Agricultural Colleges and Experiment Stations, Washington, D. C., August, 1891, No. 8, Lectures on Investigations at Rothamsted Experimental Station; No. 9, The Fermentations of Milk; No. 10, Meteorological Work for Agricultural Institutions; No. 11, A Compilation of Analyses of American Feeding Stuffs; No. 12, Organization Lists of the Agricultural Experiment Stations and Agricultural Schools and Colleges in the United States, June, 1892; No. 13, Organization Lists of the Agricultural Experiment Stations and Agricultural Schools and Colleges in the United States, April, 1893; No. 14, Proceedings of a Convention of the National League for Good Roads, January, 1893; No. 15, Handbook of Experiment Station Work; No. 16, Proceedings of the Sixth Annual Convention of the Association of American Agricultural Colleges and Experiment Stations, New Orleans, Louisiana. November, 1892; No. 17, Suggestions for the Establishment of Food Laboratories.

Miscellaneous Bulletins.—No. 1, Proceedings of Knoxville Convention of Association of Agricultural Colleges and Stations, January, 1889; No. 2, Proceedings of Washington Convention of the Association, November, 1889; No. 3, Proceedings of Champaign Convention of the Association, November, 1890.

Farmers' Bulletins.—No. 1, The What and Why of Agricultural Experiment Stations; No. 2, Illustrations of the Work of the Stations; No. 9, Milk Fermentations and their Relation to Dairying; No. 11, The Rape Plant.

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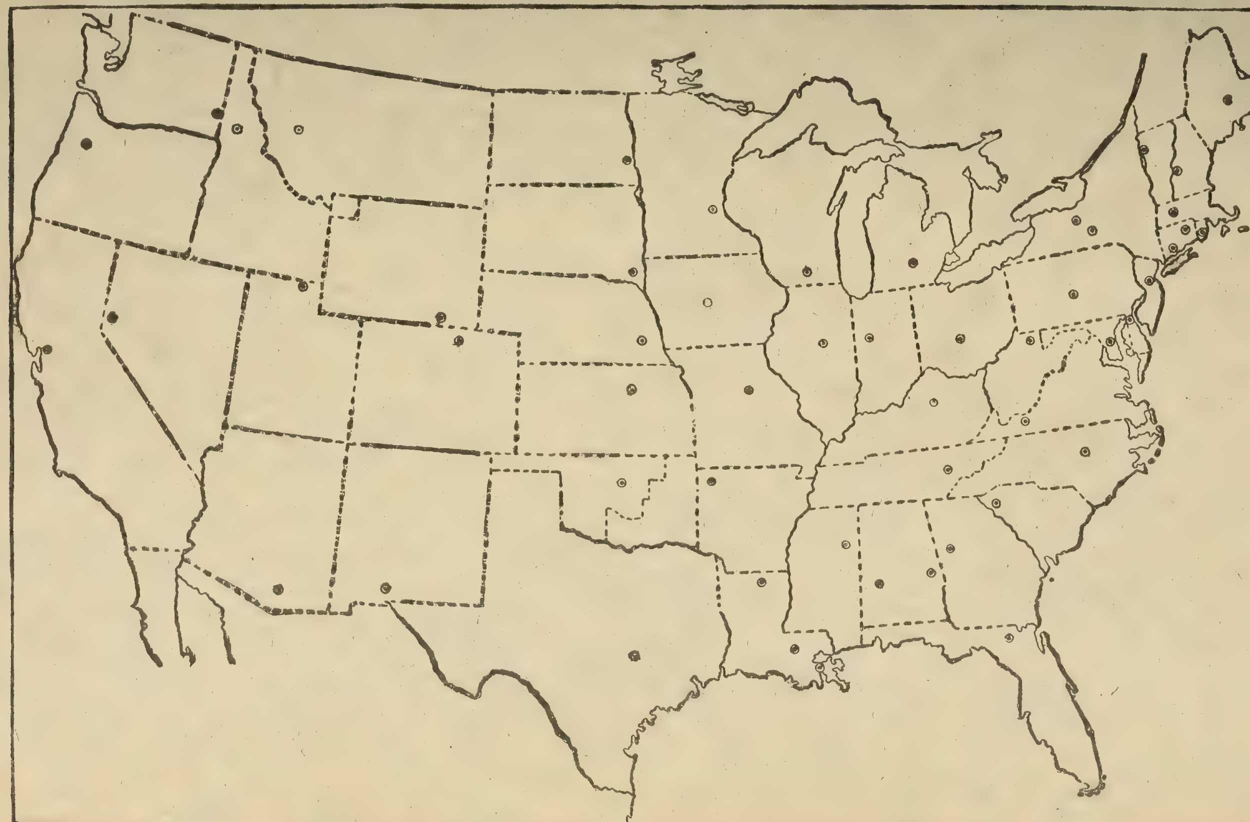

The Agricultural Experiment Stations in the United States.

R. Kent Beattie

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U. S. DEPARTMENT OF AGRICULTURE

OFFICE OF EXPERIMENT STATIONS

Vol. V No. 2

EXPERIMENT STATION RECORD

PUBLISHED BY AUTHORITY OF THE SECRETARY OF AGRICULTURE

WASHINGTON
GOVERNMENT PRINTING OFFICE
1893

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U. S. DEPARTMENT OF AGRICULTURE

OFFICE OF EXPERIMENT STATIONS

Vol. V No. 2

EXPERIMENT STATION

RECORD

PUBLISHED BY AUTHORITY OF THE SECRETARY OF AGRICULTURE

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EXPERIMENT STATION RECORD.

Vol. V. No. 2.

That the proper care and use of manure is one of the most important factors in a rational and successful farm management is fully appreciated in those countries where farming is most nearly reduced to a scientific basis. The great practical importance of this subject has so impressed agricultural investigators, in France and Germany especially, that they have made the production, care, and uses of barnyard manure the subject of extensive and exhaustive studies. In this country comparatively little has been done, but the investigations at that station (New York Cornell) which has given most attention to this subject have clearly brought out the high value of the manure annually produced by all kinds of farm live stock, the influence of food and other factors on its quality, and the wastefulness of the ordinary methods of managing manure.

The Record endeavors to give, from time to time, the latest advances in this important field with the hope of stimulating more thorough and comprehensive inquiry among American investigators, and through them to awaken popular interest in a phase of American farm management which is undoubtedly much neglected.

In order that the foreign work might be presented in a concise form and by an expert on the subject, the Office engaged A. Hébert, of the agricultural experiment station of Grignon, France, to prepare the article published in this number of the Record (see p. 142), which briefly summarizes the results of the most reliable French investigations on the production, care, value, and use of barnyard manure. Some of the most thorough of these investigations have been carried out by the author during a number of years at the Grignon station, and it is believed that his summary of this work can not fail to prove instructive and suggestive.

The vital importance of this subject to the agricultural community can hardly be urged too strongly, for although the value of farm

manure is very generally admitted, comparatively little attention is given to improving the methods of its care and use.

It is not difficult to discern the general reason upon which is based the high esteem of barnyard manure by those who have most carefully studied it. In the first place, as Hébert remarks, it may be considered a perfect manure, possessing both the physical and chemical properties which ameliorate and enrich the soil; and, in the second place, it is well adapted to all conditions of climate, soil, and crop. It must also be remembered that it is fertility drawn from the farm—a part of the farmer's capital—and therefore can not be neglected if that capital is to be kept intact, unless the draft is compensated from other sources. An idea of the actual money values involved may be gained from the estimate by Prof. Roberts, of the New York Cornell Station, based on extensive experiments. According to this the total value of the manure produced on a small farm carrying 4 horses, 20 cows, 50 sheep, and 10 pigs during seven winter months amounts to about $250. Can the farmer afford to neglect such an important farm resource?

On large farms in Germany, where a careful system of bookkeeping is pursued, it has been found that stock-raising is not profitable unless the manure is carefully saved, and evidence is not lacking in America to show that raising farm live stock would be more generally profitable if the manure was carefully conserved and wisely used.

Manure is a valuable source of nitrogen, the most fugitive and costly element of plant food that must be supplied to soils. It is not only rich in nitrogen itself, but it is a powerful promoter of nitrification in the soil. Its judicious management and use would therefore result in a great reduction of the outlay for expensive nitrogenous fertilizers so freely purchased and used at the present time.

There are not lacking those who advocate the use of green manuring with leguminous plants in conjunction with mineral fertilizers as a substitute for barnyard manure; but no less an authority than Julius Kühn, in a recent article,* argues with great force that the turning under of leguminous plants as green manure is less remunerative than feeding the same plants to stock and returning the manure obtained to the soil, and it is a notable fact that the American station (Alabama) which has probably given the greatest attention to the subject of green manuring, has reached a similar conclusion. Whatever conclusions are reached by individual investigators on this point, there can be no doubt of the fact that by neglecting to save and use barnyard manure the farmer is allowing a constant drain upon his resources, which must make itself felt in time.

A consideration of facts such as these fully confirm the old adage that "the true foundation of successful agriculture is the manure pile." It is of the highest importance to American agriculture that this should not only be appreciated, but more generally acted upon.

*Ztschr. Landw. Cent. Ver. Sachsen, 1893, Nos. 1, 3, and 4 (E. S. R., vol. v, p. 226).

FARM MANURE.

A. Hébert.

Farm manure is a mixed fertilizer at once vegetable and animal. It is produced by a special fermentation of the litter of stables, under the influence of the feces of the animals under which it is placed. The particular conditions under which this fermentation is produced, the composition of the products used and of those obtained at the end of the reactions, the advantages or disadvantages resulting from various methods employed in practice for the preparation of manure, have been in recent years the object of numerous and interesting studies. It is the result of this work which we wish to summarize in the following pages:*

I.—SUBSTANCES WHICH GIVE MANURE ITS VALUE.

Manure, without doubt, was the first fertilizer employed in a general and systematic manner by the tillers of the soil. Its use dates back to the beginning of regularly organized cultivation of the soil. The constant and rational use of this fertilizer is evidence of the effectiveness which is universally conceded to it and of the beneficial influence which it exercises on the physical and chemical properties of the majority of soils. Manure is, in fact, what might be termed a perfect fertilizer—it is at the same time organic and mineral; it contains nitrogen, phosphates, potash, and lime; its organic matter decomposes readily; its physical character promotes aëration of the soil rendering it more porous, and facilitating the respiration of the roots and the nitrification of the nitrogenous materials which nourish plants; finally, manure is a fertilizer which repairs the losses of humus substances from the soil. It has long been maintained that these substances are unavailable to plants in their original state, and that time must be allowed for their decomposition and transformation into soluble products, but experiments conducted by Petermann at the Agronomic Institute of Gembloux, Belgium, have shown that these substances just as they exist in the soil are capable of being dialyzed through membranes and are therefore assimilable by plants, at least by certain species of plants.

In extended studies of the composition of straw the author discovered a very carbonaceous substance which Dehérain† has named

* The divisions of the subject in this paper, as well as a large part of the figures which are cited, are taken from P. P. Dehérain's *Chimie Agricole* and from the files of *Annales Agronomiques*.

† Recherches sur la fabrication du fumier de ferme.—Ann. Agron., 14 (1888), p. 97.

decomposable vasculose. This substance appears in the manure in large proportions and, as is explained further on, one benefit derived from the application of manure to the soil is the restoration of this carbonaceous principle which is exhausted by growing certain plants. It is therefore desirable to so conduct the preparation of the manure that those fermentations are promoted, which will give, even at the loss of a small amount of nitrogen, a fertilizer containing in a free state a large quantity of black substance (*matière noire*). It should be mentioned, however, that many agriculturists do not adopt this idea and look upon manure principally as a means of returning to the soil the nitrogenous and mineral matters removed by crops. These authorities are, therefore, especially concerned to prevent the loss of these substances by various means which arrest or prevent unusual fermentation of the manure and as a consequence the formation of black substance.

Before we proceed to study the reactions which take place in the interior of the manure heap, we should investigate the composition of the materials which enter into its constitution. These substances are (1) the animal excrement, and (2) the litter.

II.—COMPOSITION OF ANIMAL EXCREMENT.

The litter of stables receives the liquid and solid feces of the animals. These products have been studied for many years from the agricultural point of view, *i. e.*, as relates to the fertilizing materials which they contain. We will review briefly the work published on this subject in recent years.

Andoynaud and Zacharewicz* found the following amounts of fertilizing materials in the feces of horses and cows:

Fertilizing constituents in the feces of horses and cows.

Kind of manure.	1,000 parts of feces contain—		
	Nitrogen.	Phosphoric acid.	Potash.
	Grams.	*Grams.*	*Grams.*
Horses:			
Urine	15.21	traces.	9.24
Solid excrement	5.58	3.50	1.00
Cows:			
Urine	10.50	traces.	13.60
Solid excrement	4.35	1.20	0.42

The amounts discharged per animal daily were:

	Nitrogen.	Phosphoric acid.	Potash.
	Grams.	*Grams.*	*Grams.*
Horses	155.5	59.5	53.8
Cows	212.0	32.4	133.7

* Contribution à l'etude du fumier de ferme.—Ann. Agron., 11 (1885), pp. 129, 337.

Calculated to amounts per year we have the following figures:

	Nitrogen.	Phosphoric acid.	Potash.
	Kg.	*Kg.*	*Kg.*
Horses	56.8	21.7	19.6
Cows	77.4	11.8	48.8

Müntz and Girard, in a similar experiment on a lot of 5 sheep,* observed an average of 2.05 kg. of feces per animal daily which contained: Water 73.6 per cent, nitrogen 0.51 per cent, phosphoric acid 0.31 per cent, and potash 0.87 per cent. Calculated per animal per year we have: Nitrogen 3.81 kg., phosphoric acid 2.54 kg., and potash 6.5 kg. Finally, Boussingault, in his *Economie Rurale*, gives for the average of 4 kg. of mixed excrement discharged per pig daily the following content of nitrogen and phosphoric acid: Nitrogen 14.8 grams, phosphoric acid 11.2; calculated per year, nitrogen 5.4 kg., and phosphoric acid 4.08.

In the following table we calculate from these figures the quantities of fertilizing materials contained in the solid and liquid excreta discharged per head yearly by the principal kinds of farm animals:

Fertilizing constituents in the feces discharged per head yearly by different kinds of animals.

	Nitrogen.	Phosphoric acid.	Potash.
	Kg.	*Kg.*	*Kg.*
Horses	56.80	21.70	19.60
Cows	77.40	11.80	48.80
Sheep	3.81	2.54	6.50
Pigs	5.40	4.08	....

Animal excrement, therefore, furnishes to the manure a large quantity of useful elements and contributes much to its value, but it is not restricted to this rôle. The urine retained by the litter supplies the moisture and alkalinity indispensable to fermentation, while in the solid excrement are added, as we shall see below, the organisms necessary to the partial destruction and fermentation of the litter.

III.—COMPOSITION OF MATERIALS USED AS LITTER.

The litter placed under animals in folds and stables is designed not only to furnish a soft and healthy bed to the animals, but also to serve as an absorbent. It is therefore important to consider the relative absorbent power of the various materials employed as litter. It is this which is shown in the following table adapted from Dehérain's *Chimie Agricole.*

*See also on this subject Ann. Agron., 12 (1886), p. 429; and Les Engrais of Münzt and Girard.

Absorption of liquids by litter.

Kind of litter.	Water retained by 100 kg. of material after 24 hours.	Number of kilos of material necessary to replace as litter 100 kg. of wheat straw.
	Kg.	*Kg.*
Wheat straw	220	100
Barley straw	285	77
Oat straw	228	96
Partially decomposed oak leaves	162	136
Peat	500-700	40
Sawdust of poplar wood	435	50
Spent tan bark	400-500	48
Air-dried vegetable mold	50	440

These figures indicate that, as regards moisture, peat and spent tan bark are decidedly the best absorbents. The absorbent properties of these materials extend moreover to the ammonium salts which are formed in the feces. Müntz and Girard, in a recent memoir,* give the following amounts of ammonia retained per kilogram of dry substance by various materials used as litters:

Ammonia absorbed per kilogram of dry matter in different kinds of litter.

	Grams.
Wheat straw	1.70
Pine sawdust	0.46
Mossy peat from Holland	8.63
Powdered peat	11.03
Siliceous earth (*Joinville-le-Pont*)	0.66
Calcareous earth	1.80
Argillaceous forest soil	2.24
Garden soil	5.38
Peaty soil	6.60

We see from these figures what decided advantage would result from mixing with the straw of the litter peaty or humus earth which would perceptibly reduce the loss of ammonia produced by the fermentation of the excrement. This practice is especially commendable if we judge of the efficiency of the manure from the point of view of its content of nitrogenous and mineral matter. For those agriculturists who maintain, on the contrary, that the preparation of manure should be conducted with a view to obtaining black substance, the use of straw is absolutely indispensable.

For a long time the chemical composition of straw was so imperfectly understood as to render investigations on manure difficult. In the first half of this century the celebrated chemist Payen declared straw to be composed of cellulose and a small quantity of nitrogenous matter and ash. Later, the presence of fatty matter, sugar, dextrine, peptic substances, and bodies analogous to starch were observed. Fifteen years

*Les pertes de l'azote dans les fumiers.—Ann. Agron., 19 (1893), p. 5.

ago Müntz,* by means of elementary analysis, showed the presence of a very carbonaceous body, which Dehérain † afterwards demonstrated to be identical with the vasculose studied by Frèmy. Even after the investigations of these chemists there was still some doubt concerning the substances designated as "starch and allied substances." All of the authorities who have studied forage plants have shown that, although a microscopic examination of straw revealed little or no starch, considerable quantities of reduced sugar were obtained by treating straw with dilute sulphuric acid. The author has shown in a recent paper ‡ that the latter is formed by the saccharification of a gum analogous to the wood gum or xylan, studied by Wheeler, Allen, and Tollens,§ which gives by hydrolysis a reducing sugar known as xylose. It is this gum which heretofore has appeared in the tables of analyses under the head of starch and allied substances. In the same article a new method of analysis of straw was described which provided for the determination of all of its constituents. Recently, G. Bertrand || isolated from straw another substance to which he gave the name lignin.**

Below is given the percentage composition of wheat straw and oat straw determined by the method of analysis referred to above:

Composition of wheat straw and oat straw.

	Wheat.	Oats.
	Per cent.	*Per cent.*
Water	10.40	8.05
Nitrogenous matter	2.42	3.57
Substances soluble in ether (fatty substances and chlorophyll)	1.18	2.98
Substances soluble in water, ashes deducted (reducing and non-reducing principles—gums, tannins)	3.37	5.70
Cellulose	33.60	27.15
Vasculose	24.00	14.20
Straw gum (calculated as xylose)	19.71	27.70
Ashes	6.34	9.85
	101.02	99.20

It is shown further on what becomes of the various elements during the fermentation of the manure.

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* Annales de l'Institut national agronomique, 1878.

† Recherches sur la fabrication du fumier de ferme.—Ann. Agron., 14 (1888), p. 97.

‡ Compt. Rend., 110, p. 969.

§ Liebig's Ann. Phys. und Chem., 260, p. 289; Ueber die Xylose oder den Holzucker—Ztschr. Ver. Rübenz. Ind.

|| Recherches sur la composition immediate des tissus vègêtaux.—Compt. Rend, June 20, 1892.

** The wood sugar gum has been found by Bertrand and the author in a large number of plants.

IV.—LOSS OF NITROGEN IN STABLES.

In a very complete memoir * Müntz and Girard have shown that very considerable losses of nitrogen may take place during the time the litter remains under the feet of the animals. The fermentation which takes place is almost entirely ammoniacal and it is probably safe to say that the loss observed is almost exclusively that of ammonia. The fact is further substantiated by the pungent odor of ammonia which is observed in stables. These investigators observed in the sheepfolds of Joinville-le-Pont 8.6 mg. of ammonia per cubic meter of air, about 400 times as much as in normal air.

Without entering into the details of the experiments carried out by Müntz and Girard, which are of little interest in this connection, it may be stated that these two scientists have observed a variable but very considerable loss of nitrogen in stables in th case of different kinds of animals—sheep, cows, and horses. These losses varied from 29 to 50 per cent of the total nitrogen in the food consumed. To reduce these losses, they advise the addition to the litter of a certain proportion of peat or of humus earth which, as shown above, have a very high absorptive power for ammonia. Their experiments demonstrated the slight efficiency of the chemical agents (sulphate of iron, plaster, kainit, superphosphate, and carbonate of lime) commonly recommended for fixing ammonia. Joulie, among others,† has made similar observations regarding manure.

V.—FERMENTATIONS OF MANURE.

The litter, when taken from under the animals, is thrown upon the manure heap to remain until carried to the fields. During this time it undergoes important transformations under the influence of certain organized ferments. If a properly constructed manure heap be examined there will be found at about a meter above the soil numerous stalactites of black substance evidently derived from manure leachings, and showing that this part of the manure is saturated with liquid. This liquid consists not only of the urine of the animals with which the straw is impregnated, but also of rainwater if the manure has not been covered, and of the sprinklings with manure leachings which are frequently made. Above this point, if the air in the interior of the manure be examined, it will be found to be composed, for the larger part, of nitrogen and carbonic acid, the latter in proportion to the oxygen which has disappeared. In many cases marsh gas appears in considerable amounts.‡ At about 1.7 meters above the soil, it will be found that the proportion of nitrogen is very slight and sometimes nil, while

* Ann. Agron., 19 (1893), p. 5 (E. S. R., vol. IV, p. 686.)

† Ann. Agron., 10 (1884), p. 289.

‡ Reiset first observed the evolution of marsh gas in manure in 1856. This gas is produced by the decomposition of the cellulose of the litter: $C_6H_{12}O_6 = 3CO_2 + 3CH_4$

the quantities of marsh gas and carbonic acid are increased. The following table gives results of analyses by Dehérain * of the gas taken from these different parts of the manure heap.

Percentage composition of the gas of manure.

	Upper part.	Central part.	Lower part.
	Per cent.	*Per cent.*	*Per cent.*
Carbonic acid	21.6	31.0	37.1
Oxygen	0.0	0.0	0.0
Nitrogen	78.4	35.5	4.9
Marsh gas (CH_4)	0.0	33.5	58.0

In taking samples of the gas, an iron rod about 1 meter long was forced into the manure heap at the desired height. This was withdrawn and replaced by a glass tube which was allowed to remain a certain time in order to give the interior atmosphere time to become uniform. This tube was connected by means of rubber tubing with an aspirator or mercury pump, by means of which the gas was drawn off for analysis.

In the upper part of the manure heap, where the air has access, aërobic fermentation goes on. This is a kind of combustion due to the organisms of manure, which is sufficiently active to elevate the temperature of this region to 50° or 60° and sometimes to 70° C. It is well known to agriculturists that in order to revive fermentation in manure it is only necessary to sprinkle with manure leachings. This liquid percolates through the mass and dissolves the larger part of the gas which is found there. It also produces in the interior a diminished pressure which draws in the outside air. In the presence of this excess of oxygen, combustion sets in with increased activity and gives rise to an elevation of temperature such as we have called attention to above.

On the contrary, in the middle and lower parts of the manure it is found that anaërobic fermentation goes on, oxygen being entirely absent here. The temperature is very slightly elevated, the thermometer registering only 25° to 35° C.

Gayon, of Bordeaux, observed in an ingenious manner the difference in the amount of heat produced by aërobic and anaërobic fermentation of manure. He made two boxes of the same dimensions, in which he placed the same quantity of manure. The first box was of open work so that the air had free access, the second was hermetically sealed. When a thermometer was introduced into the latter box, it showed a temperature of only 25° C., while in the aërated box it registered 55° to 60° C. It was, therefore, the supply of air which determined the evolution of heat.

What is the origin of the ferments which induce fermentation of manure, the transformation of the cellulose into marsh gas and carbonic

* Recherches sur les fermentations du fumier de ferme: Ann. Agron., 10 (1884), p. 385.

acid? If the excrement of herbivorous animals, freshly discharged, be examined under the microscope before it has had time to become contaminated by the dust of the atmosphere, there will be found small clustered refracting bacteria which move with great activity. If small fragments of this material be placed in a Pasteur matrass containing a small amount of straw moistened with alkaline solution, all of which has been previously sterilized in an oven at 120°, there will be observed at the end of a few days a very slow evolution of gas which, when collected over mercury and analyzed is found to be a mixture of carbonic acid, nitrogen, and marsh gas. To succeed with this experiment it is necessary to place the matrass in a sterilizing oven maintained at a constant temperature of 55° C., which, as Schlösing has observed,* is the most favorable temperature for the development of the ferments of manure. It appears evident, therefore, that the microbes which induce marsh gas fermentation in manure are derived from the intestines of the animals. They find in the manure a culture bed all ready for them, raised to the proper temperature by the oxidation going on in the upper part of the heap, and sufficiently alkaline to promote the multiplication of the bacteria. There is, moreover, another means of proving that these organisms are derived from the stomach of the herbivora. If the contents of the intestines of an animal recently slaughtered be examined under the microscope, ferments presenting the same characters as those of manure will be found, and if the gas contained in the intestines of the same animal be carefully removed after death and submitted to chemical analysis, it will be found to be composed of marsh gas and carbonic acid, as in the case of manure. It appears, therefore, that the elements set free in the manure (straw and excrement) are a result of the prolongation of the digestive functions—a continued digestion, to use the phrase of Dehérain.

VI.—THE REACTIONS WHICH TAKE PLACE IN MANURE.

Litter placed in the upper part of the manure heap undergoes, as we have seen, more or less complete oxidation. The aërobic fermentation which goes on in this region attacks the more easily reducible substances of the straw—reducing sugars, dextrine, tannin, vegetable acids, fatty substances, and straw gum—which are transformed in whole or in part into the products of combustion—water and carbonic acid. Afterwards when this layer of manure is covered by other litter, anaërobic fermentation goes on under the influence of bacteria derived from the digestive tract, and the remaining substances are attacked. This continued digestion results, as we have said, in the more or less complete transformation of the cellulose of the straw into marsh gas and carbonic acid.

As regards the vasculose, it is partially destroyed and strongly mod-

*Ann. Agron., 18 (1892), pp. 5–18. (E. S. R., vol. II, p. 737.

ified by all of the reactions which the litter has undergone, but a large part of it still remains, which is dissolved in the alkaline liquid of the manure leachings.

All of these conclusions have been verified by investigations* at the agricultural school at Grignon, comprising a number of synthetical experiments on the formation of manure. In these experiments a known weight of straw of definite composition was placed in a flask, and an alkaline solution of known strength added. This was inoculated with a few cubic centimeters of manure leachings, and the flask was then allowed to remain in an oven at a constant temperature of 55° C. After a certain time the experiment was stopped, and the straw and the liquid analyzed to observe the changes due to fermentation. The results obtained in one of these experiments which lasted three months are given below.

Absolute quantities of substances contained in the straw at the beginning and end of the experiment.

	Substances introduced.			Substances obtained.			Difference.
	In the straw.	In the alkaline liquid added.	Total.	In the straw.	In the liquid.	Total.	
	Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Aërobic fermentations:							
Ammoniacal nitrogen	....	2.64	2.64	....	0.40	0.40	—2.24
Organic nitrogen	0.39	....	0.39	0.24	0.96	1.20	+0.81
Total nitrogen	....	....	3.03	....	....	1.60	—1.43
Fat and chlorophyll	0.46	....	0.46	0.30	....	0.30	—0.16
Reducing sugars	1.21	....	1.21	....	....	....	—1.21
Dextrine	0.02	....	0.02	....	....	....	—0.02
Gums, tannin, acids, etc	0.30	....	0.30	0.26	....	0.26	—0.04
Cellulose	14.12	....	14.12	6.18	....	6.18	—7.94
Vasculose	14.01	....	14.01	9.07	2.68	11.75	—2.26
Straw gum	10.00	....	10.00	4.67	....	4.67	—5.33
Ash	3.57	2.75	6.32	2.40	4.00	6.40	+0.08
Anaërobic fermentations:							
Ammoniacal nitrogen	....	2.64	2.64	....	1.40	1.40	—1.24
Organic nitrogen	0.39	....	0.39	0.25	1.23	1.48	+1.09
Total nitrogen	....	....	3.03	....	....	2.88	—0.15
Fat and chlorophyll	0.46	....	0.46	0.29	....	0.29	—0.17
Reducing sugars	1.21	....	1.21	....	....	....	—1.21
Dextrine	0.02	....	0.02	....	....	....	—0.02
Gums, tannin, acids, etc	0.30	....	0.30	0.15	....	0.15	—0.15
Cellulose	14.12	....	14.12	5.98	....	5.98	—8.14
Vasculose	14.01	....	14.01	7.53	1.38	8.91	—5.10
Straw gum	10.00	....	10.00	3.97	....	3.97	—6.03
Ash	3.57	2.75	6.32	1.96	3.60	5.56	—0.76

On examining the table we observe, first, that the straw has lost about one half of its weight. This loss is borne principally by the three most abundant elements—cellulose, vasculose, and straw gum. It is especially large for the first of these substances, of which 7 to 8 grams disappeared. The enormous loss of cellulose, which reaches more than 50 per cent, is not at all surprising when it is understood that the disintegration of the straw—a condition necessary to the formation of manure—is due to the dissociation of the cellulose under the influence of marsh gas ferments. These organisms appear, moreover, to

*Compt. Rend., 115, p. 1321; Ann. Agron., 18 (1892), p. 536.

work as well in case of fermentations in the presence of air as in other cases, and it is almost impossible to determine from our investigations the conditions best suited to bring about the destruction of the cellulose.

As to the vasculose, the losses are very variable. A part is dissolved in the alkaline liquid, and a part is probably oxidized by the fermentation and disappears as carbonic acid and water. Still it is true that the loss of vasculose is less than that of cellulose, and generally does not exceed 30 or 35 per cent of the vasculose originally contained in the straw. The same fact was also observed in manure kept in piles, in which the proportion of vasculose was found to be quite large, both in the fermented straw and in the leachings. This substance is highly charged with carbon, and serves to repair the losses from cultivated soils of carbonaceous organic substances and to furnish the humus so necessary to certain species of plants.

The loss of straw gum, while less than that of cellulose, is still considerable.

As to the other materials contained in small proportions in the straw—fat and chlorophyll, gums, tannin, vegetable acids, and reducing and non-reducing principles—the last two, which ferment very rapidly, disappear completely; the others sustain losses, which vary with the conditions of the experiment.

The fixed mineral substances naturally do not vary during the preparation of manure. The differences which we have found in the ash are due to errors in sampling, or possibly of analysis.

It remains now to examine a point which has been much discussed, namely, the transformations and the loss of nitrogen during the fermentation of manure.

VII.—ORIGIN OF THE NITROGENOUS SUBSTANCES OF MANURE.

The nitrogenous substances of manure constitute one of its most important elements of fertility. Straw contains about 0.5 per cent of nitrogen (3 to 3.5 per cent of nitrogenous matter). This nitrogenous matter partially set free during the disintegration of the straw under the influence of the ferments of manure is dissolved in the leachings along with the vasculose in which it is imbedded.

A very considerable amount of nitrogen is furnished to the manure by the solid and liquid excrement of the animals. In these materials the nitrogenous matter is found largely in the state of urea or carbonate of ammonia. In a very short time the urea subjected to the action of the air and of the ferment discovered by Van Tieghem,* is transformed by hydration into carbonate of ammonia, as follows:

$$(NH_2)_2\,CO + 2H_2O = (NH_4)_2CO_3.$$

The carbonate of ammonia, with the salts of potash of the excrement, serves to furnish to the manure an alkaline medium in which the marsh

* Compt. Rend., 58, p. 210.

gas ferment is able to develop normally and exercise its function under favorable conditions.

As to the transformation which the organic matter undergoes during the preparation of the manure, the observations of the authorities which we have cited are not in complete accord. Dehérain and Joulie have observed a partial transformation of the ammonia obtained by the fermentation of the urea into nitrogenous organic compounds, a transformation produced by the vital activity of ferments. Schlösing, on the other hand, has observed the opposite phenomena—the increase of the ammonia at the expense of the albuminoids. At the same time, while the last investigator did not observe an evolution of free nitrogen, Reiset and Joulie, experimenting on manure, and Dehérain, experimenting on straw inoculated with manure leachings, have found a notable loss of nitrogen in the free state. From these divergent results one is led to believe that the reactions which take place in manure are extremely complex and that the kind of fermentation produced is determined by the conditions of each experiment.

VIII.—LOSSES OF NITROGEN.

The carbonate of ammonia formed by the fermentation of urea is very soluble in water, and it is so extremely volatile that there is danger that a certain proportion of it may be lost if the manure heap is not properly cared for or kept in a favorable condition of moisture. Loss from this source has been observed in the synthetical experiments by the author above referred to. This result can be explained by the addition of the relatively large amounts of volatile alkali which were introduced, and which are never met with so abundantly in practice; but the largest loss of nitrogen was undoubtedly in the free state. This loss of nitrogen appeared to be much greater in the aërobic fermentation than in other cases. This fact has been pointed out by Dehérain in a previous article on manure.*

In order to prevent the loss of nitrogen in the form of ammonia, some authorities advise the addition to the manure of various salts—plaster, sulphate of iron, and sometimes sulphuric acid. Other agriculturists, on the contrary, oppose this practice, on the principle that in order to promote the particular fermentation which is necessary to the production of manure, it is indispensable that the liquid be perceptibly alkaline; otherwise the straw is not sufficiently decomposed, and its vasculose is not rendered sufficiently soluble and readily assimilable by plants.

Besides, the principal use of manure is overlooked, which is, as already pointed out by Dehérain, the supplying of black carbonaceous substance to replace the losses of humus in the soil. Moreover, in regularly sprinkled and properly cared for manure heaps, the losses of ammonia are certainly extremely small. This has been demonstrated

* Ann. Agron. 14 (1888), p. 97.

by numerous tests made on manure in piles at the school at Grignon. In these observations samples of the gases were taken from the interior of the pile in the manner already described. The gas was drawn out by means of an aspirator, first through a flask intended to retain the liquid which was carried along with the gas, and afterwards into a flask containing 10 c. c. of titrated sulphuric acid. After drawing off a known quantity of gas the flask of acid was taken to the laboratory and distilled in a Schlösing apparatus, an excess of potash being added to replace the ammonia and to retain the carbonic acid which would vitiate the results if the acid were titrated directly. The ammonia evolved was collected in 10 c. c. of very dilute titrated sulphuric acid. The final titration of the unsaturated acid was made with lime water. Proceeding in this manner, numerous examinations of the gas at various times and at different heights in the manure heap were made, but perceptible amounts of ammonia were never observed.

IX.—PROXIMATE AND ULTIMATE ANALYSES OF MANURE AND MANURE LEACHINGS.

If a certain quantity of manure be stirred up on a coarse sieve with a slow current of water, the coarser undecomposed straw, which evidently comes from the litter, is separated out. If the rest of the manure is thrown on to a finer sieve, the latter retains the straw which has undergone partial decomposition in the digestive tract of the animals. The liquid obtained in this process contains the soluble constituents of the straw and excrement which ordinarily appear in the manure leachings. Besides, there are found, as has been said, a number of nitrogenous and mineral substances held in the solution of the vasculose.

We have reviewed neither the modifications undergone by the constituents of the straw and excrement nor the composition of the various parts of the manure to which we have called attention in the chapter relating to the reactions which take place in the manure heap.

As to the elementary composition of manure and manure leaching, it must be understood that it varies with the different kinds of animals which furnish the manure, the care and management of the manure, the duration of fermentation, meteorological conditions, etc. Numerous factors influence their composition. We give below the proximate composition of two mixed manures, one fresh and the other well rotted, and one sample of manure leachings.*

Composition of manure.

Kind of manure.	Water.	Nitrogen.	Phosphoric acid.	Potash.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Fresh manure	75	0.39	0.18	0.45
Well-rotted manure	79	0.58	0.30	0.50

*These data are taken from Dehérain's Chimie Agricole.

Composition of manure leachings.

	Parts per thousand.
Water	991.100
Organic matter	1.654
Mineral matter	5.260
Ammonia	0.560
Organic nitrogen	0.051
Total nitrogen	0.611
Phosphoric acid	0.104
Potash	2.660

Studies of the elementary composition of manure from different animals have shown that the manure of horses and sheep is richer in nitrogen and potash than that of pigs and cattle.

It is known that the disagreeable odor of manure leachings is due to the sulphide of ammonia which it contains. Sulphureted hydrogen enters into the composition of the substances derived from the reduction of the sulphates contained in the digestive fluids of the animals. Under the influence of anaërobic ferments these sulphates are transformed into sulphides which, in the presence of the carbonate of ammonia of the excrement, produce sulphide of ammonia.

X.—CARE OF MANURE.

We have seen that the principal precautions necessary to prevent losses of ammonia consist simply, as pointed out by eminent agriculturists, in regularly and properly watering the manure with the leachings. In case of drought if the leachings are insufficient the lack should be made up with water. A too prolonged drying of the manure heap is liable, among other undesirable results, to arrest or retard marsh gas fermentation.

On July 9 of last year during a period of drought the author collected samples of gas from the interior of the manure heap at 1 meter above the ground. The manure at this time was very dry and badly fermented. The gas obtained had an odor slightly resembling that of butyric compounds. Analysis of the gas gave the following results: Ammonia, none; carbonic acid, 33.93 per cent; oxygen, none; marsh gas, 2.18 per cent; and nitrogen, 63.89 per cent.

On August 3, after a series of rain storms, other samples of gas were taken from the same heap in the same manner. The manure was moist and well fermented. The gas obtained gave the characteristic odor of manure. Analysis showed the following composition: Ammonia, none; carbonic acid, 35.07 per cent; oxygen, none; marsh gas, 30.75 per cent; and nitrogen 34.18 per cent. Marsh-gas fermentation had been actively reëstablished.

The two analyses of the gas given above show that fermentation of manure depends upon the presence of a sufficient quantity of moisture.

Another precaution necessary to prevent loss of fertilizing materials in manure consists in piling the manure in heaps without spreading,

and carefully collecting the leachings which drain out in a pit, from which they can be pumped up and periodically returned to the heap. We have noticed in the preceding chapter the fact that the leachings contain a large quantity of substances useful to plants which would be lost if the liquid was not carefully saved.

Müntz and Girard* have determined the loss sustained by manure exposed to the air. Their experiments were made on manure from sheep and cows.

Losses in manure exposed to the air.

	Fresh.	After six months.	Loss.
Manure from sheep:	*Kg.*	*Kg.*	*Kg.*
Weight, wet	7,160.0	4,210.0	....
Dry matter	2,341.0	1,755.0	586.0
Total nitrogen	43.7	38.7	5.0
Phosphoric acid	44.4	35.9	8.5
Potash	122.4	96.0	26.4
Manure from cows:			
Weight, wet	5,329.0	3,270.0	....
Dry matter	2,339.0	1,504.0	835.0
Total nitrogen	43.1	32.7	10.4
Phosphoric acid	21.3	19.8	1.5
Potash	77.3	65.4	11.9

XI.—MANAGEMENT OF MANURE.

The difficulties met with in the preservation of manure are increased by the necessary farm practice of preserving the manure during the period between its removal from the stable and its transport to the fields before planting. It is important, therefore, to find means by which the losses of fertilizing elements during this time are reduced to the least possible amount.

Manure is commonly cared for or disposed of in three different ways. In some cases the soil of the stalls is removed to a level below that of the outside. The animals stand constantly on the litter and pack it closely. Fermentation goes on there and the manure is allowed to remain under the animals until it is carried to the fields, fresh litter being added from time to time as necessary.

Another practice is to carry the manure regularly from the stables and place it in manure pits, where it is closely packed by young animals which are allowed to remain on it for a while.

Generally, however, in France the manure is placed on plats of packed earth inclined from the center to the sides and surrounded by a gutter which receives the leachings draining out and carries them to a pit from which they are pumped up and distributed over the manure heap by means of movable wooden gutters. It is well to provide two manure plats so arranged that when one is full (when the manure is 2.7 to 3 meters high) it may be allowed to ferment undisturbed while the other is used.

*Les Engrais.

The manure is carried from the stables to the top of the manure heap in wheelbarrows over an inclined plane of boards. It is well to smooth down the sides of the heap to prevent the free access of air and loss of leachings.

XII.—USE OF MANURE.

As regards the use and efficiency of manure in the soil we have to distinguish two cases, application to strong soils and application to light soils. Manure generally produces little result in strong soils. On such it is best to use it in the fresh and unrotted condition. In this condition it acts not only by the elements which it supplies, but also by rendering the soil more porous and lighter and in facilitating aëration of the soil which results in an increased oxidation of the nitrogenous substances contained in the manure and in their transformation into nitrates so useful to plants. Sometimes the results obtained in culture without manure on strong soils are quite remunerative. A celebrated example is the experiment of Lawes and Gilbert at Rothamsted, in which wheat has been grown without manure with good returns during thirty-two consecutive years. In similar experiments with barley carried on for twenty consecutive years (1852–1871) on the same soil the yield was not sensibly reduced. Recently Pagnoul, at the Agronomic Station of Arras, has made a similar observation with sugar beets, which he has cultivated on strong soil for ten consecutive years without manure.

In light soils, on the other hand, manure is able to produce its full effect. The highest efficiency of this fertilizer depends upon a number of factors, fertility of the soil, kind of plants cultivated, etc. The results obtained on different soils will therefore vary widely. Dehérain, in field experiments at Grignon, on moderately light soil, obtained good yields of oats and potatoes during five consecutive years without manure. A. Girard, on the contrary, considerably increased the yield of a special variety of potatoes (Richter Imperator) by heavy manuring. For certain plants, such as corn grown for fodder and sugar beets, all agriculturists agree as to the good effect produced by manure. These plants, in fact, readily avail themselves of the organic matter with which manure is charged.

It has been pointed out above that manure acts in the soil through the mineral and organic materials which it supplies and through the physical changes which it brings about in the soil. The latter allow the nitrifying ferments to exercise their function under favorable circumstances and to gradually transform the nitrogenous matter of the soil and of the fertilizer first into nitrites and afterward into nitrates. Nitrates are especially needed by plants and are very easily assimilated. Aside from the solubility of the black substance, of which we have already spoken, this nitrification is the principal cause of the efficiency of manure; and since this phenomenon goes on in a much more complete and rapid manner in light soils than in strong it follows that the latter will profit less by applications of manure.

Dehérain has made this the subject of decisive experiments at the Agronomic Station at Grignon. He observed the comparative nitification in the light soil of Grignon and in the strong soil of Wardrecques (Pas-de-Calais), both with and without manure. These experiments were carried out in large earthenware pots capable of holding 50 kg. of soil, so arranged that the drainage water might be collected for the determination of the nitric nitrogen. The results obtained with manure are given below:

Nitric nitrogen in the drainage water from manured soil in excess of that in drainage water of unmanured soil.

Date.	Light soil (Grignon).	Strong soil (Wardrecques).
1891.	*Mg.*	*Mg.*
Mar. 24	204	150
Apr. 7	294	205
May 30	143	168
June 9	64	89
July 22	154	28
Sept. 4	111	33
Oct. 11	122	99
	1,093	712

It will be seen that of the two soils manured under the same conditions the lighter furnished a considerably larger amount of nitric nitrogen. The same experiments serve also to show the good influence of manure on nitrification. Below are given the figures obtained by this investigator on the same Grignon and Wardrecques soils with and without application of manure:

Nitric nitrogen in the drainage water of manured and unmanured soils, March to October, 1891.

	Manured soil.	Unmanured soil.	Difference.
	Mg.	*Mg.*	*Mg.*
Grignon	2,224	1,131	1,093
Wardrecques	1,307	595	712

This nitrifying action of manure has also been demonstrated by Müntz and Girard,* who compared the nitrifying action of various nitrogenous fertilizers on different soils. The fertilizers were added at the rate of 0.5 gram of nitrogen per kilogram of soil. The following table gives the results obtained with different kinds of fertilizers in experiments which lasted six and a half months:

Nitric acid formed in different soils.

	Light soil of Jouiville.	Very strong argillaceous and calcareous soil.	Acid soil of Brittany.
	Grams.	*Grams.*	*Grams.*
Sulphate of ammonia	2.690	0.051	0.000
Dried blood	1.620	0.036	0.000
Cow manure	1.092	0.249	0.662

*Ann. Agron., 17 (1891), p. 289.

The figures show that although on the light soil the manure nitrified much more slowly than the ammonium salts and the dried blood, both of which were transformed with exceptional rapidity, still it was able to nitrify to a considerable extent.

It will be noticed, moreover, that excellent results were produced by the addition of manure to the very strong soil. In this the sulphate of ammonia and the dried blood did not nitrify to an appreciable extent, but the manure, by the physical changes which it produced in the soil, rendering it more porous, nitrified better than the ammonia salts and blood. Finally it will be observed that in the acid soil where the latter fertilizers did not nitrify at all, on account of the lack of a base, the manure, on account of its inherent alkalinity, was able to nitrify a considerable portion of its nitrogen.

We have called attention to the fact that the black substance of manure exercises a decisive action on certain plants. This has been brought out very clearly in experiments by Dehérain.* For carrying out these experiments two parallel series of 5 large pots capable of holding 50 kg. of soil were arranged as follows:

Number.	Kind of soil.	Manure.
1-1*a*	Soil in good state of culture	Without manure.
2-2*a*	Soil exhausted by a culture of sixteen years without manure.	Without manure.
3-3*a*	Same exhausted soil	Chemical fertilizers.
4-4*a*	Same exhausted soil	Black substance of manure in 1890 and chemical fertilizers in 1891.
5-5*a*	Same exhausted soil	Black substance of manure in 1890 and 1891, and chemical fertilizers in 1891.

The fertilizers applied were analyzed and so compounded that pots 3-3a, 4-4a, and 5-5a contained the same quantities of nitrogen, phosphoric acid, potash, and lime, the only difference being that pots 4-4a and 5-5a contained more of the carbonaceous matter of manure than the others.

Rye grass was cultivated in the series with simple numbers, while in the other series clover was grown. The yields obtained were as follows:

Yields of rye grass and clover on soils differently manured.

Number.	Weight of the dry crop.	
	Rye grass.	Clover.
	Grams.	*Grams.*
1-1*a*	45	89
2-2*a*	39	65
3-3*a*	102	72
4-4*a*	64	99
5-5*a*	65	95

*La transpiration des vegetaux et l'Emploi des Engrais.—Ann. Agron., 18 (1892), p. 465.

While the black substance of manure produced little effect on the rye grass, the maximum yield of which was obtained by the use of chemical fertilizers, more favorable results were observed in the case of clover. These experiments lead to the conclusion that the black substance of manure is assimilable only by certain species of plants, and this conclusion is corroborated by observations by a number of agriculturists.

As to the duration of the action of manure it is difficult to speak definitely. The nature of the soil, the climatic conditions, and the plants cultivated are some of the factors which determine this point. It may be said that in the majority of cases, after two or three years of good crops, the efficiency of manure although not entirely destroyed is considerably reduced.

ABSTRACTS OF PUBLICATIONS OF THE AGRICULTURAL EXPERIMENT STATIONS IN THE UNITED STATES.

CHEMISTRY.

E. W. ALLEN, *Editor.*

Report of the chemist of Louisiana Station, B. B. ROSS (*Louisiana Stas. Bul. No. 22, 2d ser., pp. 737–746*).—This consists of a report of the work of the chemical laboratory of the station for the year 1892, including, among other things, analyses of refuse from a moss-ginning factory, soils and subsoils, "vegetable pear," and a number of foreign varieties of sugar cane. Studies are also reported in several lines on analytical methods, which are referred to below.

In making numerous tests of the adaptability of the electrolytic method to invert sugar determinations during the past year, it was found that the following modification of Formanek's method gave most satisfactory results:

The precipitation of the cuprous oxide is effected in a beaker and the precipitate is at once brought upon an asbestos filter in an ordinary funnel and the washing with hot water is performed in the usual manner. It will not be found necessary to completely transfer the precipitate to the filter, and when the washing is concluded, the filter and contents are placed in the original beaker and the funnel rinsed with a nitric acid solution containing 4 c. c. of acid of 1.42 specific gravity per 100 c. c. of solution.

The dilute acid is added to the contents of the beaker until a bulk of about 200 c. c. is secured, and after the platinum electrodes are placed in the liquid, connection s made with a battery giving a current equivalent to 0.5 to 0.7 c. c. electrolytic gas per minute.

The anode employed is a flat spiral of platinum wire of the form devised by Luckow, and is allowed to rest on the bottom of the beaker, while a platinum cylinder of the usual form, suspended vertically, receives the deposit of copper.

No attempt is made to dissolve the cuprous oxide, either on the filter or in the beaker, before the circuit is closed, it being found that the solution of the precipitate and the deposition of the copper proceeded simultaneously and continuously after the flow of current had commenced. [The method was tested in a number of trials on pure dextrose.]

These figures attest the accuracy of the results to be secured by this method when it is properly executed, and numerous other practical tests with sugar products of various kinds further tend to confirm the conclusions drawn from these experiments. A complete deposition of the copper can be readily secured in eight hours, and it was observed that the copper films obtained by this process were remarkably bright and entirely free from sponginess.

A method for the direct determination of citrate-soluble phosphoric acid has also been worked out at the station, which is described as follows:

After completion of the 30 minutes' digestion of the sample with citrate solution filter out at once into a dry vessel 25 c. c. of the solution; if the liquid is filtered

directly into a dry burette, 25 c. c. can be readily transferred to another vessel without dilution. After cooling, run 25 c. c. of the solution into a digestion flask of 250–300 c. c. capacity, add about 15 c. c. of concentrated sulphuric acid and place the flask on a piece of gauze over a moderately brisk flame; in about eight minutes the contents of the flask commence to darken and foaming begins, but will occasion no trouble if an extremely high or a very low flame is avoided. In about 11–12 minutes the foaming ceases and the liquid in the flask appears quite black; about one gram of mercuric oxide is now added and the digestion is continued over a brisk flame. The operation can be completed in less than half an hour with ease, and in many cases in twenty-five minutes. After cooling, the contents of the flask are washed into a beaker, ammonia is added in slight excess, the solution is acidified with nitric acid, and after the addition of 15 grams of ammonium nitrate the process is conducted as usual.

In case as large an aliquot as 50 c. c. of the original filtrate is used, 10 c. c. of sulphuric acid are added, and the digestion is conducted in a flask of 300–500 c. c. capacity; after the liquid has blackened and foaming has progressed to a considerable extent, the flask is removed from the flame, 15 c. c. more of sulphuric acid are added, and the flask and contents are heated at a moderate temperature for two or three minutes; the mercuric oxide is then added and the operation completed as before described.

Comparative tests of this process and the regular method are being made on all samples of fertilizers analyzed, and it is designed to continue the investigation.

Honey analysis, A. J. COOK (*Michigan Sta. Bul. No. 96, July, 1893, pp. 16*).—In view of the "great doubt in the minds of many beekeepers whether even our best chemists could surely detect adulteration," a large number of samples of honey of known origin, collected by the author, together with samples of honey mixed with glucose, and others made by bees from pure granulated sugar sirup, were sent to H. W. Wiley, of this Department, M. A. Scovell, of the Kentucky Station, and R. C. Kedzie, of the Michigan Station, for analysis. The results of these analyses are tabulated with the comments of the analysts. We are assured by these analyses that—

(1) Chemists can easily detect adulteration of honey by use of glucose in all cases where it is likely to be practiced. The same would be true if cane sugar sirup was mixed with the honey.

(2) A probable method to distinguish honey-dew honey from honey adulterated with glucose has been determined by these analyses. The right-handed or slight left-handed rotation, together with the large amount of ash and small amount of invert sugar, indicate honey-dew honey. As honey-dew honey will never be put on the market, this question is of scientific rather than practical importance.

(3) As yet the chemist is unable to distinguish between cane-sugar sirup honey—by which we mean cane-sugar sirup fed to the bees and transformed by them into honey, and not cane sirup mixed with honey, which is adulteration pure and simple, though a kind not likely to be practiced—and honey from flowers. As the best cultivated taste can not thus distinguish, this seems of slight importance. If it should prove to be important to be able to distinguish them, it is probable that the chemist will discover the means, as chemistry has very delicate eyes, and can usually search out very slight differences.

BOTANY.

WALTER H. EVANS, *Editor.*

Report of the botanist of Louisiana Station, A. T. PRESCOTT (*Louisiana Stas. Bul. No. 22, 2d ser., pp. 721–723*).—Notes on the present and future work of the department and the enumeration of the forage plants which withstood the encroachment of coco (*Cyperus rotundus*) and other weeds. Of 104 species of grasses and forage plants tested only the following were successful: Texas blue grass (*Poa arachnifera*), Bermuda grass (*Cynodon dactylon*), crab grass (*Panicum sanguinale*), alfalfa (*Medicago sativa*), spotted medick (*M. maculata*), crimson clover (*Trifolium incarnatum*), and white clover (*Trifolium repens*).

A device for illustrating the root growth of plants, W. M. HAYS (*North Dakota Sta. Bul. No. 10, May, 1893, pp. 47–49, plate 1*).—A frame is made of inch gas pipe. If for corn it should be 4 feet square at the top and 6 feet deep. This frame is sunk in a hole in the earth just large enough to receive it, and the hole filled with sifted dirt which will easily wash out when sprayed. On each layer of earth 2 or 3 inches deep a section of 2-inch mesh wire netting is laid, and so on until the frame is filled. A single plant is allowed to grow in each frame. When the corn is in the dough stage the dirt is washed out by means of a spray. A trench is dug around the frame, and after the first inch of dirt has been washed away from around the posts, the layers of netting are wired to the corner posts so as to retain them in position after the dirt has been washed out. This netting serves to keep the roots almost in their natural position. In washing use a spray and wash out the top first, so as to avoid undermining any of the earth.

ZOÖLOGY.

Birds of Michigan, A. J. COOK (*Michigan Sta. Bul. No. 94, Apr., 1893, pp. 148*).—This bulletin contains the text of the Michigan laws for the protection of game, a bibliography of the birds of Michigan, and an illustrated description of the birds of the State. A very complete index to the bulletin materially enhances its value.

Gophers and moles, F. L. WASHBURN (*Oregon Sta. Bul. No. 25, Apr., 1893, pp. 14–24, plate 1, figs. 9*).—The breeding season of the mole is early in Oregon, pregnant females having been captured February 28 and 30. Poisoning moles with strychnine on small pieces of beef gave inconclusive results. The use of strychnine on small pieces of potato introduced into the burrows has been fairly effective in destroying pocket gophers. Six gopher traps and one automatic gopher gun are figured.

The Oregon ground squirrel (*Spermophilus douglasi*) is mentioned in the bulletin under the name "California ground squirrel," "digger squirrel," or "gray gopher" (*Spermophilus beecheyi*) as destructive to fruit trees and wheat.

METEOROLOGY.

W. H. BEAL, *Editor.*

Meteorological observations at Massachusetts State Station (*Massachusetts State Sta. Report for 1892, pp. 337–342*).—Monthly and quarterly summaries for the year 1892. The summaries for each quarter are compared with similar summaries for 1891. The mean temperature for the year was 45.68° F., the total precipitation 35.21 inches, and the snowfall 39.43 inches.

Meteorological observations at Massachusetts State Station (*Massachusetts State Sta. Buls. Nos. 48, June, 1893, p. 1; and 49, August, 1893, p. 1*).—Notes on the weather and summaries for May, June, and July, 1893, of observations at the station on temperature, precipitation, and direction of the wind.

Meteorological observations at Massachusetts Hatch Station, C. D. WARNER and F. L. WARREN (*Massachusetts Hatch Sta. Met. Buls. Nos. 53, 54, 55, and 56, May, June, July, and August, 1893, pp. 4 each*).—Daily and monthly summaries of observations for May, June, July, and August at the meteorological observatory of the station.

Meteorological conditions for 1892, W. M. HAYS (*North Dakota Sta. Bul. No. 10, pp. 69, 70*).—This includes notes on the weather; determinations of the per cent of water in a cultivated soil at different depths during the months of April, May, June, July, August, September, and October; and the maximum and minimum temperatures and mean rain-fall for each month in the year.

WATER—SOILS.

W. H. BEAL, *Editor.*

Analyses of water (*Massachusetts State Sta. Report for 1892, pp. 296–300*).—Tabulated analyses of 109 samples of water with reference to drinking quality, and directions for interpretation of the results of analysis.

The soils of Maryland, M. WHITNEY (*Maryland Sta. Bul. No. 21, June, 1893, pp. 58, map 1*).—"The work done since the last report to the experiment station [Annual Report for 1891, pp. 249–296; E. S. R., vol. IV, p. 17] consists of the collection and examination of a large number of samples of soils from Maryland, and the classification of all the most important formations, exclusive of those on the Eastern shore; the collection of soil samples from other parts of the country and an examination of some of this material. * * * This collection [contains 1,500 samples and] includes samples from nearly all of the larger and more important agricultural regions of the United States, as well as the soils best adapted to the different staple crops, collected from the most typical localities."

The results of an examination of some of these typical soils, viz, the rice soils of South Carolina, have been reported in Miscellaneous Report No. 6 of the Division of Statistics, U. S. Department of Agriculture (E. S. R., vol. IV, p. 848).

In Bulletin No. 4 of the U. S. Weather Bureau (E. S. R., vol. IV, p. 371) the author has already discussed the principal topics to which the present bulletin is devoted. A feature of the latter is a preliminary report on the chemical composition of the type soils of Maryland.

Prof. R. L. Packard was authorized by the U. S. Department of Agriculture to make a thorough study of the chemical composition of some of the typical Maryland soils to supplement the work on the physical structure and properties of these soils. Prof. Packard was to inquire into the chemical composition of the soils with special reference to the form of combination of the chemical elements and the identification of the minerals still remaining in the soil as a source of supply of the plant food. Much of Prof. Packard's time has necessarily been taken up with the study of methods of analysis and methods for the separation and identification of the minerals, and these methods are only just now well in hand. The methods and the results of his work will be described at length at another time.

The ultimate chemical composition of thirteen type subsoils has, however, been determined and the results are tabulated and discussed.

On the whole, there appears to be a remarkable uniformity in the ultimate composition of these subsoils, and little to indicate that the increasing agricultural value of the lands is dependent upon the actual amount of plant food in the subsoils. * * * The cause of the high percentage of potash in the limestone soil has been partially investigated by Prof. Packard, who finds a quantity of a dull, yellow-colored, amorphous-like mineral in the clays, having a high potash content.

A map showing the area and distribution of the principal soil formations of Maryland is given.

From the chemical and physical studies of these soils thus far made the author draws the following conclusions:

(1) There are a large number of soil formations in Maryland, giving about 12 or 15 distinct types of soil.

(2) These soil types have very different and very characteristic agricultural values.

(3) The difference in the chemical composition of these soils will not account for the difference in their agricultural values.

(4) Difference in climatic conditions and changing seasons have far more effect on the development and yield of crops than fertilizers have.

(5) The texture of these soil types is very different, and there is a greater difference between the conditions of moisture and heat maintained by these soils than ordinarily experienced in changing seasons or in widely separated localities.

(6) The development and yield of crops on these soil types, and therefore their relative agricultural value, is dependent upon these conditions of moisture and heat which they maintain for the crops.

(7) The relation of these soils to moisture and heat is largely dependent upon the arrangement of the soil grains and upon the amount and condition of the organic matter in the soil. In our ordinary fertilizing materials we have very powerful and potent means of maintaining or of changing these conditions, and it is to this rather than to the amount of plant food they supply that the principal effect of fertilizers is due.

(8) This does not detract in anyway from the value or importance of our commercial fertilizers, but only explains their action on a new basis from that generally accepted.

FERTILIZERS.

W. H. BEAL, *Editor.*

Analyses of fertilizers at Massachusetts State Station (*Massachusetts State Sta. Buls. Nos. 48, June, 1893, pp. 2–6, 8; and 49, August, 1893, pp. 2–6, 8*).—The schedule of trade values of fertilizing ingredients in raw materials and chemicals for 1893, and tabulated analyses of 125 samples of fertilizing materials, including commercial fertilizers, tankage, cotton-hull ashes, Florida phosphate, natural phosphate, boiler soot, mill sweepings, saltpeter, sewage, horse manure, and ashes.

Analyses of fertilizers, J. L. HILLS (*Vermont Sta. Buls. Nos. 34 April, 1893, pp. 3; and 35, May, 1893, pp. 15*).—Schedules of trade values of fertilizing ingredients for 1893, with notes on valuation; and tabulated analyses of 64 samples of fertilizing materials, including commercial fertilizers, ashes, peat, muck, peat ashes, tankage, bone meal, and odorless phosphate.

A comparison of the average composition [of 27 standard brands selected from those sold in the State during the years 1892 and 1893] shows that in 1893 the fertilizers contained a little more of each ingredient except potash, and only a deficiency of 0.25 per cent in this respect. The differences, however, are not large, the total increase of valuation being only 36 cents. As there was last year a decrease of this same amount, the average composition of the fertilizers this year is just the same as it was two and three years ago.

The valuation is less, for the wholesale prices of the materials from which fertilizers are made are constantly falling.

Analyses of commercial fertilizers, H. B. MCDONNELL (*Maryland Sta. Special Bul. K, June, 1893, pp. 8*).—Scale of prices of fertilizing materials for 1893, with notes on valuation; directions for sampling fertilizers, and tabulated analyses of 48 samples of commercial fertilizers.

Composition and use of fertilizers, P. COLLIER (*New York State Sta. Bul. No. 55, n. ser., May, 1893, pp. 271–359*).—A discussion of the principles underlying the preparation and use of commercial fertilizers, reprinted largely from bulletins Nos. 25, 26, 27, 32, and 33 of the station (E. S. R., vol. II, pp. 366, 659, 735; III, pp. 89, 311); a schedule of trade values of fertilizing materials for 1893, with notes on valuation; a compilation of analyses of commercial fertilizing materials and farm products, and the text of the State fertilizer law.

Commercial fertilizers, C. A. GOESSMANN (*Massachusetts State Sta. Report for 1892, pp. 248–290, 302–307*).—Remarks on the fertilizer control in Massachusetts; schedule of trade values for fertilizing materials for 1892; text of the State fertilizer law; a list of licensed dealers; analyses of 260 samples of fertilizing materials, including commercial fertilizers, bones, ashes, muriate of potash, sulphate of potash, nitrate of soda, dissolved boneblack, cotton-hull ashes, ivory ashes, limekiln ashes, corncob ashes, wool waste, horn shavings, tobacco

leaves, pine needles, pine barrens grass, peat, sludge, muck, soot, manure leachings, gypsum, calcium carbonate, Florida phosphates, Virginia phosphatic marls, ivory dust, tankage, fish, bat guano, and cotton-seed meal, and a compilation of analyses of fertilizing materials.

Field experiments with commercial fertilizers, C. E. THORNE and J. F. HICKMAN (*Ohio Sta. Bul. No. 49, May, 1893, pp. 15–49*).

Synopsis.—The bulletin gives reports on experiments (1) on wheat at the station and in different parts of the State, (2) on crops in rotation, (3) on oats at the station, and (4) on corn at the station and in different parts of the State. The experiments in general indicate that commercial fertilizers can be profitably used on cereal crops in Ohio only in connection with green manuring with plants "which have the power of obtaining nitrogen from sources inaccessible to the cereals."

The experiments here reported on are continuations of those commenced in 1889 and described in Bulletins vol. III, No. 2, vol. IV, No. 3, and vol. V, No. 3 of the station (E. S. R. vol. II, p. 121; III, pp. 241, 887). The general plan of the experiments may be briefly stated as follows: "A tract of uniform land is divided into plats containing one tenth or one twentieth acre each; the plats are 16 feet wide and are separated by alleyways 2 feet wide. Under every second alleyway a tile drain is laid. In the case of the wheat plats the soil is clay, lying upon the boulder clay of the drift, and that upon Huron shale at a depth of 15 to 20 feet. It was formerly covered with forest, in which beech and elm predominated, and was wet and heavy before being drained. The plats on which corn and oats are grown have a gravel subsoil, which gives partial drainage."

The experiments of this station with fertilizers now include four years' continuous culture of wheat on the same land, with and without fertilizers, on the farm hitherto occupied by the station in Columbus and belonging to the State University; three years' similar culture of wheat in Columbiana County; four years' continuous culture of oats on the Columbus farm; five years' continuous culture of corn on the Columbus farm and in Columbiana County, and 14 coöperative experiments, made in 1889, 1890, 1891, and 1892 by farmers in Ashtabula, Holmes, Miami, Huron, Licking, Butler, and Washington counties, besides several years' study of crops grown in rotation and of plants grown in boxes.

Fertilizers on wheat grown continuously on the same land (pp. 17–23).—"This was the fourth successive crop of wheat on these plats." The fertilizers used were dissolved boneblack, 320 pounds per acre, muriate of potash, 80 pounds, and nitrate of soda and dried blood, in amounts furnishing 25 pounds of nitrogen per acre, used singly, two by two, and all three together; slag phosphate, 300 pounds, and rock phosphate, 300 pounds, each in combination with muriate of potash and nitrate of soda; and barnyard manure and linseed meal singly. Eight check plats remained unmanured.

Dried blood was applied in the fall and the nitrate in the spring. The yield of grain and straw and the weight of grain and straw per

bushel are tabulated and compared with the results obtained during three previous years. The following table gives the average results:

Fertilizers on wheat, four years in succession.

	1889.	1890.	1891.	1892.	Average.
Average yield of grain per acre on unfertilized plats .... bushels..	42.8	31.1	31.4	26.5	33.0
Average increase (+) or decrease (−) per acre due to fertilizers .... bushels..	+1.7	+4.4	−0.8	+2.3	+1.9
Average yield of straw per acre on unfertilized plats .... pounds..	3,588	3,240	3,672	2,673	3,294
Average increase due to fertilizers .... pounds..	233	835	1,202	949	805
Average weight per bushel of grain from unfertilized plats .... pounds..	....	$64\frac{1}{8}$	$62\frac{1}{4}$	60	62
Average weight of straw per bushel of grain on unfertilized plats .... pounds..	84	104	116	100	101

We have not discovered that the fall application, whether of nitrate or dried blood, has been any advantage.

In the crops of 1890 and 1891 the nitrate of soda produced a very marked effect on the growth of the plant, producing a dark green, rank growth of foliage. This effect was less marked this season, possibly because of the constant rains. * * *

The effect of superphosphate in stimulating an early and heavy growth of straw has been as marked this year as in previous seasons. The superphosphate plats could be distinguished within a few weeks after seeding, and their superior growth was more and more manifest until the wheat had headed out. * * *

Considering now the four years' work as a whole, we find that no chemical fertilizer or combination of such fertilizers has, in a single instance, produced sufficient increase of grain to pay the cost of the fertilizer, except possibly, in the case of [one plat where the result] was probably accidental. What is much more remarkable is the fact that the fertilizers have apparently had, in many cases, a smaller effect in the fourth season of continuous cropping, the fertilizers being applied every year, than they had on the clover sod.

Whether the increase of crop indicated when a complete fertilizer was used on the clover sod was actually due to the fertilizer, or was only the result of irregularities in the soil, it is impossible to tell. This point is worthy of further investigation. There seems no reason to doubt, however, that the increase indicated in 1890 was actually due to the fertilizers, and this, it will be seen, was more than double that obtained two years later from the same plats and in a much smaller average yield.

The lodging of wheat (pp. 24, 25).

[From observations during three years it appears that] where nitrate and superphosphate were used in combination the wheat lodged badly, both in 1891 and 1892. Where they were used separately the tendency to lodge was not so great, and where nitrate was used in combination with Carolina rock or Thomas slag, instead of bone superphosphate, the wheat stood fairly well.

It would seem that the nitrate and superphosphate are equally responsible for throwing the wheat down. * * *

The increasing tendency to lodge manifested in 1891 and 1892 is probably not altogether due to the fertilizers, as the wheat grown on unfertilized land has manifested this tendency to a greater degree during these two seasons than during the two preceding; but it is plainly partly due to the fertilizers, and whether a smaller application would produce a better proportionate result is a question which can not be satisfactorily answered until the station has more land at its disposal for this work.

Coöperative experiments on wheat (pp. 26–29).—An experiment on the same plan as the above was also begun in 1889 in Columbiana County, Ohio, but the crop in 1892 was a total failure. The tabulated results for the previous years showed that "the average yield of this land is only about half as great as that on which the experiments at the station are conducted, yet the increase from fertilizers has been practically no greater in Columbiana than in Franklin County, except that in 1891 the superphosphate seems to have produced a slight gain in Columbiana instead of a loss, as in Franklin."

Fertilizers on crops in rotation (pp. 29–31).—The plan and method of manuring was the same as that described in Bulletin vol. v, No. 3 (E. S. R., vol. III, p. 887), except that 80 pounds of muriate of potash instead of 160 pounds was used. The table of results for two years "shows that the rotation employed in this experiment has added from 5 to 7 bushels to the crop of wheat, the treatment being similar in other respects, and it shows that, while the actual production of straw, in the absence of nitrogenous fertilizers, has been greater under rotative than under continuous cropping, yet it has invariably required less straw to carry a bushel of grain under rotation, the treatment being otherwise the same."

Fertilizers on oats grown continuously on the same land (pp. 31–34).—The plan of the experiment was the same as in the case of wheat. The results during four years (1889–'92) are tabulated and discussed. The average results may be seen in the following table:

Fertilizers on oats, four years in succession.

	1889.	1890.	1891.	1892.	Average.
Average yield of grain per acre on unfertilized plats..bushels.	44.0	17.2	42.8	34.1	34.6
Average increase of grain per acre due to fertilizers.....do...	4.7	4.5	5.3	2.9	4.3
Average yield of straw per acre on unfertilized plats..pounds.	3,557	2,252	2,400	2,917	2,768
Average increase of straw per acre due to fertilizers ..do...	338	586	212	313	362

It appears that each of the three fertilizing materials used—superphosphate, muriate of potash, and nitrate of soda—has in nearly every case produced an increase of crop. It would seem that potash is having a more favorable effect upon the oats than upon the wheat, and it seems that the combination of nitrogen with either phosphoric acid or potash has on the average produced a larger increase than that following the separate use of either of the three materials, but no single fertilizer, and no combination of fertilizers, has produced an increase in the average crop sufficient to pay the cost of the fertilizer.

In the case of the oat straw it will be observed that, while there is a general increase of straw following the use of the fertilizers, this increase is usually much smaller than in the case of wheat.

Fertilizers on corn grown continuously on the same land (pp. 34–39).—The experiments with corn in the same series as the above have been carried on for five years. The results for that period are given in tables. The average results are given in the following table:

Fertilizers on corn, five years in succession.

	1888.	1889.	1890.	1891.	1892.	Average.
Average yield per acre of grain on unfertilized plats ....bushels*	90.2	61.8	46.6	57.3	65.4	64.3
Average increase of grain per acre due to fertilizers ....bushels	1.4	2.9	3.0	8.9	8.0	4.9
Average yield per acre of stalks on unfertilized plats ....pounds	6,720	3,342	2,478	3,333	3,720	3,919
Average increase of stalks per acre due to fertilizers ....pounds	382	285	541	579	929	....

*Of 70 pounds of ears.

It appears that there has been a loss of crop in four seasons out of five on the plat dressed with superphosphate alone, and in three of the five seasons on the plat treated with potash alone, while the plat on which these two substances have been used together shows practically no gain in the average of the five seasons. It seems quite clear that in this series of experiments superphosphate and potash have added nothing to the crop of grain, and but little to the growth of stalks, until combined with nitrogen.

The plat dressed with nitrate of soda shows a small gain in every season except the first, and that dressed with nitrate and superphosphate shows an increase every year, the average gain for the five seasons amounting to nearly 7 bushels, a gain which is not increased by the addition of potash. Practically the same increase is shown by the combination of nitrate and potash, however, without any superphosphate; hence we must conclude that nitrogen is the controlling factor in producing an increase of the corn crop on this soil.

In the case of the corn the fertilizers seem to be having a greater effect during the later years of the experiment, and this appears to be due, not to the exhaustion of the unfertilized plats—for their average yield in the fifth season of the test was greater than for any other season except the first, and for the fourth season it was but little behind that of the second—but to a gradual accumulation of available plant food in the fertilized plats. * * *

Even in those seasons when the effect of the fertilizers was most strongly marked it has in most cases required a dollar's worth of fertilizer or more to produce a bushel of increase in the crop.

Of the various complete fertilizers used the one containing Carolina rock as the source of phosphoric acid has produced the largest average increase of corn in proportion to cost of fertilizer.

A one year's experiment on the same plan on the new station grounds at Wooster, Wayne County, Ohio, indicated that phosphoric acid was the element most needed on that soil, and potash next, while nitrogen in any form had little effect.

Coöperative experiments on corn (pp. 39–47).—Experiments on practically the same plan as that outlined above have been carried out by farmers in Columbiana, Washington, and Butler Counties, Ohio, for periods of from three to five years. The results are tabulated and discussed.

In almost every instance in all our field experiments on corn an increase of crop has followed the use of nitrate of soda in combination with muriate of potash or superphosphate, one or the other, and it seems to make very little difference which;

but the increase has frequently been reduced when both superphosphate and potash have been added to the nitrate.

In all our work with fertilizers, upon wheat and oats as well as corn, the effect of phosphoric acid seems to be chiefly shown in the stalk and straw. * * *

Apparently, an excess of phosphoric acid stimulates the growth of stalk and straw at the expense of the grain, and thus in wheat the weight of straw may be increased and that of the grain at the same time diminished, while in corn both stalk and grain may be reduced by the less perfect development of leaf. This phenomenon has been manifested so frequently in our experiments that there is no longer room to doubt that the yield of grain may be actually reduced by the use of fertilizers containing phosphoric acid or potash but no nitrogen.

But it does not follow that the extensive purchase of nitrogen is necessary. A careful study of these experiments will show that nearly if not quite every case, in which a profitable increase of grain has followed the use of superphosphate without nitrogen, occurred either on sod or on soils which had been cropped in systematic rotation, whereby a good supply of decaying vegetation had been maintained; this decaying vegetation apparently furnishing the nitrogen required to balance the phosphoric acid added in the fertilizers.

It would seem, therefore, that if chemical fertilizers are to be used with any prospect of profit in the production of cereal crops it must be in connection with the culture of some nitrogen-storing crop, such as clover, grown as frequently as possible in order to secure the greatest possible accumulation of vegetable matter in the soil.

Summary (p. 49).

These experiments must be continued further before positive conclusions can be drawn, but at the present date the following tentative conclusions seem to be justified:

(1) The use of superphosphate and potash, separately or in combination, but without nitrogen, has frequently caused a loss of grain in crops of corn and wheat on soils deficient in vegetable matter.

(2) The yield of straw or stalks has almost invariably been increased by the use of superphosphate.

(3) The use of superphosphate has frequently, and that of potash has occasionally, been followed by a considerable increase of crop, both of grain and straw or stalks, on sod ground or land containing an abundance of decomposing vegetable matter.

(4) An increase of grain in the crop has generally followed the use of nitrate of soda, and this has happened in almost every case when the nitrate has been used in combination with superphosphate or potash.

(5) When a complete fertilizer has been used, containing both phosphoric acid and potash, in combination with nitrogen, the phosphoric acid being carried in less active forms than bone-black superphosphate, an increase of crop has resulted in practically every case; but at present prices of fertilizers and grain, respectively, this increase has invariably cost more than its value in the market.

(6) While, therefore, these experiments demonstrate the possibility of producing a regular and certain increase in the yield of cereal crops by the use of a complete chemical fertilizer, yet they show that if such fertilizers are to be used with any prospect of profit in Ohio in the production of cereal crops and as a part of a regular system of agriculture, that system must provide for the accumulation in the soil of the largest possible quantity of organic nitrogen, through the culture, in short rotations, of plants which have the power of obtaining nitrogen from sources inaccessible to the cereals.

FIELD CROPS.

J. F. DUGGAR, *Editor.*

Field experiments, C. A. GOESSMANN (*Massachusetts State Sta. Report for 1892, pp. 170–210*).

Synopsis.—Notes on experiments with different nitrogenous fertilizers on soja bean; different phosphatic fertilizers on serradella; varieties of grasses, forage plants, root crops, and vegetables; mixtures of grasses and forage plants, and general statements regarding the farm work of the station.

Nitrogen experiments on soja beans (pp. 170–177).—An experiment on 11 eighth-acre plats, several of which had received no nitrogenous fertilizers for six years. Eight hundred pounds of barnyard manure with 32 pounds of potash-magnesia sulphate and 18 pounds of dissolved boneblack was used on one plat; on the others 50 pounds of dissolved boneblack, 25 pounds of muriate of potash, or 48.5 pounds of potash-magnesia sulphate was applied alone and in connection with 29 pounds of sodium nitrate, 43 pounds of dried blood, or 2.25 pounds of ammonium sulphate per plat. Soja bean seed was sown in drills on all the plats May 16, 1892, at the rate of 7 pounds per plat. The results of measurements of the plants showing the rate of growth are tabulated for each plat. One plat suffered, as in preceding years, from the attack of some parasitic enemy, another showed some irregularity from receiving a different amount of seed from the other plats. The yields for all plats are tabulated, ranging from 7.15 to 11.05 tons of green fodder per acre.

In the earlier period of growth the plats on which nitrogen was supplied in the form of nitrate of soda showed a deeper green color than plats where other forms of nitrogen were used. The plants without nitrogen maintained a light green color throughout the season. The yield of the plats receiving only mineral fertilizers was fully one third less than where barnyard manure and nitrate of soda furnished the supply of nitrogen.

When the crop was harvested for silage September 7 and 8 the plants showed no signs of seed pods or blossoms, thus differing from the white and black soja beans previously raised at the station. The advantage of this variety, if any, consists in the large amount of vegetable matter it produces as compared with the early maturing varieties. Analyses of early and late varieties are given.

Special phosphoric acid experiments on serradella (pp. 197–201).—The plats which were used in 1891 for an experiment with winter wheat, described in the Annual Report of the station for 1891 (E. S. R., vol. IV, p. 27), were sown to serradella May 17, 1892. The same fertilizers were applied as in the case of the preceding wheat crop. These consisted of ground phosphatic slag, Mona guano, ground Florida phosphate, South Carolina phosphate, and dissolved boneblack, all in combination with

nitrate of soda and potash-magnesia sulphate. Serradella seed was sown in drills $2\frac{1}{2}$ feet apart and cut for silage September 9 and 10 while perfectly green. The yields varied from 13.69 to 9.5 tons of green fodder per acre. The largest yields were with ground phosphatic slag and with Mona guano; the smallest with ground phosphate and dissolved boneblack. Analyses of the crop both as to feeding and fertilizing constituents are given.

Grass experiments (pp. 178–181).—Notes are given on the growth at the station of Kentucky blue grass, meadow fescue, Herd's grass (timothy), and mixtures of redtop with Kentucky blue grass, English rye grass, Italian rye grass, Herd's grass, and meadow fescue, also mixtures of English rye grass and Italian rye grass, and meadow fescue and Herd's grass. These were grown on plats two fifteenths of an acre n area. The heaviest yield (4,575 pounds of hay per acre) was made by Herd's grass sown September, 1889. This was closely followed by mixtures of redtop with Herd's grass and with Italian rye grass.

Experiments with garden crops (pp. 182–189).—The yields are given of celery, lettuce, spinach, beets, cabbages, tomatoes, and potatoes raised on eighth-acre plats, each plat manured with mixtures of 30 pounds muriate of potash, 40 pounds dissolved boneblack, and either 75 pounds dried blood, 47 pounds nitrate of soda, or 38 pounds ammonia sulphate; also the yields of carrots and Globe mangel-wurzels manured at the rate of 600 pounds of bone meal and 200 pounds of nitrate of potash per acre. The yield of carrots was 20,530 pounds per acre; of mangel-wurzels 35,680 pounds per acre.

Experiments with new forage crops and with field crops (pp. 190–196, 202, 203).—Notes are given on soja beans, serradella, Bokhara clover (*Melilotus alba*), spring vetch, kidney vetch (*Anthyllis vulneraria*), sainfoin, yellow trefoil (*Trifolium agrarium*), yellow lupine (*L. luteus*), white lupine (*L. alba*), blue lupine (*L. cœruleus*), forest pea (*Lathyrus sylvestris*), common buckwheat, Japanese buckwheat, silver-hull buckwheat, stachys (*Stachys affinis*), prickly comfrey, Jerusalem artichoke (*Helianthus tuberosus*), pyrethrum, winter rape and summer rape, English horse bean, cowpea, and Jackson Wonder bean. The yield of artichoke tubers was at the rate of 16,400 pounds per acre, while stachys tubers attained a diameter of scarcely one eighth of an inch. Winter rape and summer rape were much the same in their character of growth and in their failure to bloom. The growth of winter rape was heavy, reaching a height of 20 inches. Serradella was grown at the rate of 12 tons per acre. Blue lupine attained a height of 38 inches, white lupine 33 inches, and yellow lupine 24 inches. Kidney vetch and yellow trefoil made a very slight growth, and the growth of sainfoin was light. The yield of potatoes manured with bone and sulphate of potash is given. Mixtures of vetch and oats and of Canada peas and oats were grown. The yields and analyses of the crops are given. The yield of a field of potatoes is also given.

Experiments with grass land (pp. 202–208).—An account is given of the treatment and yield of a meadow of 16 to 17 acres since 1886.

Report on general farm work (pp. 209, 210).—Brief remarks on the current farm work, and a statement of the amounts of hay and other feeding stuffs raised during the year.

Field experiments with corn at Baton Rouge, D. N. BARROW (*Louisiana Stas. Bul. No. 22, 2d ser., pp. 669–671*).—*Varieties* (pp. 669, 670).—Fifteen varieties were tested. The most productive was Roberts, followed by Welborn Conscience. The percentages of shuck, cob, and grain are tabulated for each variety.

Distance experiments (pp. 670, 671).—On unfertilized land in rows 4 feet apart one stalk was left every 18 and 24 inches; two stalks were also left at these distances. The whole experiment was repeated on rows 5 feet apart. The following table gives the results:

Yield of corn grown at different distances.

Number of stalks and distance apart in drill.	Width of row.	Yield per acre.
	Feet.	*Bushels.*
One stalk, 18 inches	4	42.1
Two stalks, 18 inches	4	67.3
One stalk, 2 feet	4	48.8
Two stalks, 2 feet	4	73.9
One stalk, 18 inches	5	47.6
Two stalks, 18 inches	5	59.6
One stalk, 2 feet	5	40.6
Two stalks, 2 feet	5	32.9

Fractional application of fertilizers (p. 671).—The amounts and kinds of fertilizers are not stated. Fertilizers were applied when the corn was planted, and the yield was 35 bushels of corn per acre. When two applications were made, one at time of planting and the other at "off-barring," the yield increased to 40.7 bushels. When three applications were made, namely, at time of planting, "off-barring," and last cultivation, the yield rose to 54.6 bushels per acre. In 1891, a dry season, two applications gave the best results.

Time of harvesting corn, D. A. KENT, G. E. PATRICK, E. N. EATON, and W. H. HEILEMAN (*Iowa Sta. Bul. No. 21, pp. 778–787*).

Synopsis.—Four lots of corn were cut September 20, September 27, October 6, and October 12. The greatest weight of ears was from the cutting of October 6; the greatest weight of fodder from the cutting of September 27. From the first to the third date the dry matter of the kernels materially increased, chiefly at the expense of the leaves, and to a less degree at the expense of the husks, cobs, and stalks.

Twelve rows of Leaming corn were divided into four plats of equal size. In each plat twenty stalks of even size and ripeness were selected and labeled for analysis. One plat was cut September 20, when the blades and husks were all green; a second plat was cut September 27, when half of the leaves were green and half dry; a third plat was cut October 6, when the ears were fully ripe, the husk breaking loose from

the ear, and when the leaves were about one third green; and a fourth was cut October 12, when the leaves were completely dried up, and some leaves were lost in cutting.

The yields of ears and fodder on the plats cut at different dates were as follows:

	Ears.	Stover.
	Pounds.	*Pounds.*
First cutting, Sept. 20	154.01	93
Second cutting, Sept. 27	161.45	98
Third cutting, Oct. 6	176.50	95¼
Fourth cutting, Oct. 12	173.25	74

These figures indicate a loss by cutting September 20 of 12.7 per cent in total weight and a loss by cutting September 27 of 8.5 per cent, as compared with the weight of the plat cut October 6.

"The field weights show that the stover had made its full development September 27, when the green coloration of the blades had half disappeared. From that time forward the nutriment in the stover began to diminish in quantity. The ears, however, did not reach their maximum growth until October 6, or nine days after the stover had begun to depreciate in value."

Analysis showed that the increase in dry matter of the whole plant was but slight after the first date of harvesting, and that subsequent changes consisted chiefly in the translocation of the several forms of matter within the plant. The total weights of dry matter of kernels and cobs together from twenty stalks were at the different dates 9.7, 10.52, 11.54, and 11.4 pounds, respectively. The increase between the first and third periods, consisting chiefly of nitrogen-free extract, was made entirely by the kernels, the cobs suffering a slight loss. Between the first and third dates of cutting the husks suffered a slight loss in every constituent of the dry matter; the stripped stalks lost slightly in total dry matter, and the decrease in every constituent of the total dry matter of the leaves was very large.

The analyses show that the plant first elaborates material and then uses this material largely in forming the ear; and that the full formation, or complete ripeness of the ear, results in considerable loss of the nutrient matter in stalk and blade—the loss being about 12 per cent on field weight and 17 per cent on dry matter This loss would probably vary with the weather. During the time of taking the samples herein considered there was no rain from first to last. * * * Our conclusion is that the corn we have under consideration should have been put in shock between September 27 and October 6.

The time to commence cutting corn is when the blades and husks have begun to dry, and the cutting should be finished when half the blades and husks have dried up. This gives about ten days for cutting corn.

In an appendix analyses of the entire plant, kernels and cobs combined and separate, husks, leaves, and stripped stalks are given.

Experiments on cotton, R. L. BENNETT and G. B. IRBY (*Arkansas Sta. Bul. No. 23, March, 1893, pp. 87-107*).

Synopsis.—These experiments include the following: (1) Rotation; (2) green manures, cotton seed, and manure; (3) commercial fertilizers; (4) upper and lower cotton bolls as sources of seed; (5) gins and ginning; (6) early and late picking. Cotton seed as a fertilizer was effective even in the second year. Plowing under pea vines caused a larger yield of cotton than plowing under pea stubble, but it was more profitable to use pea vines for hay and return the manure to the cotton crop. Cotton-seed meal, kainit, superphosphate, and floats, applied singly in 1891 slightly increased that season's yield of cotton, but gave inconclusive results in 1892. Seed from bottom bolls germinated better and yielded an earlier and larger crop of cotton than seed from top bolls. Slow ginning and early picking gave better staples than rapid ginning and late picking.

Rotation (pp. 87, 88).—Results are tabulated for the first, second, and third years of a rotation experiment with cotton, corn, field peas, and barley, in continuation of work reported in Bulletin No. 18 of the station (E. S. R., vol. III, pp. 762, 763).

Pea vines vs. barnyard manure as a fertilizer for cotton (pp. 88, 89).—Three plats of one acre each were used, and all planted in cotton. Plat 1 received no fertilizer. Plat 2 received an application of 1,604 pounds of cotton seed. A crop of cowpeas had been raised on this plat the previous year, the vines of which were plowed under after the peas were picked. Plat 3 received the manure from feeding to cattle 1,604 pounds of cotton seed and the same weight of pea-vine hay. The yield of seed cotton on the three plats was as follows:

	Pounds.
Plat 1. No manure	1,008.0
Plat 2. Pea vines plowed under and cotton seed	1,557.8
Plat 3. Manure from feeding pea hay and cotton seed	1,454.8

"The peas picked from pea vines turned under on plat 2 paid all the cost of their cultivation and left a profit besides. In plat 3 the cost of producing the pea hay was exceeded by the gains of the animals that consumed the hay. The manure of plat 3 caused the cotton to grow throughout the season, delaying its maturity and consequently its yield."

Effect of cotton-seed meal, kainit, superphosphate, and floats on the cotton crop of the second year (p. 90).—In 1891, 500 pounds of each of these fertilizing materials was applied on different plats. Cotton was grown on these plats that year and the following year. The results as to a residuary action of the fertilizers were inconclusive.

Effect of cotton seed used as a fertilizer on the crop of cotton of the second year (p. 90).—In 1891, 500 pounds of cotton seed were applied to one plat, while another plat was unfertilized. Cotton was grown on both plats for two years. The yield of seed cotton indicated that the cotton seed affected the second year's crop.

Pea vines and pea stubble as soil renovators (pp. 91, 92).—On two plats peas were grown. On one plat the peas were picked and the vines plowed under as a preparation for next year's crop of cotton, and on the

other plat the vines were cut for hay. Cotton was grown on the plats the year following, and also on a third plat, which had not grown a crop of peas, as a check. The yields of seed cotton were as follows: Vines plowed under, 1,409 pounds of seed cotton; pea stubble plowed under, 1,291 pounds; plat not treated, 1,008 pounds.

Economy of feeding pea vines instead of plowing them under (pp. 93–96).—On two plats of a quarter of an acre each cowpeas were grown in drills. On one plat the peas were picked and the vines left on the ground till spring, when they were plowed under, together with 426 pounds of cotton seed, which had been heated. On the other plat the vines and pods were cut and cured for hay. The hay, together with 426 pounds of cotton seed, was fed to a range steer, and the resulting manure applied to the plat from which the hay was cut. Cotton was grown on both of these plats. An accident prevented a direct comparison of the yields on the two plats. The pea-vine hay was not all fed, and complete data for the feeding are not given; but the author figures out a large financial gain in favor of feeding instead of plowing under pea vines and cotton seed.

Productiveness of cotton seed from bottom and top bolls (pp. 96–98).—The cotton crop from seed grown in bottom bolls was larger and nearly a month earlier than that from seed grown in top bolls. In Bulletin No. 18 of the station (E. S. R., vol. III, p. 763) is recorded the results of a comparison of bolls grown near the bottom of the stalk with those grown near the top. Five hundred bottom bolls gave a larger amount both of lint cotton and cotton seed than did the same number of bolls from near the top.

Seed from these top and bottom bolls was planted the following spring. The seed from bottom bolls germinated well; from the top bolls poorly. The dates when the first boll opened were, for the plats from the bottom boll seed, September 10; from the top boll seed, October 1. October 1, 25 per cent of the crop from bottom boll seed was open, but only 3 per cent of the crop of the other plat. The crop from seed grown in bottom bolls yielded 1,043 pounds seed cotton per acre; from seed grown in top bolls only 760 pounds.

Experiments in ginning (p. 99).—The Winship, Smith & Sons huller gin and the Eclipse gin were tested and the character of the resulting staple determined.

Slow ginning gave a staple valued at ¼ cent per pound higher than that from rapid ginning.

Effect of early and late picking (p. 99).—The quality and value of lint picked in October was compared with that picked in January. The earlier picking was valued at 9¾ cents per pound of lint; the later picking at 8¼ cents.

Characteristics of varieties (pp. 99–104).—General remarks on the principal types of cotton and the culture necessary for each. There are illustrations of Welborn Pet, Peerless, Mammoth Prolific, and Peterkin varieties.

The author believes that the early varieties are less liable to injury from the bollworm and cotton caterpillar.

Field experiments with cotton at Baton Rouge, D. N. BARROW (*Louisiana Stas. Bul. No. 22, 2d ser., 1893, pp. 664–669, 675–678*).

Synopsis.—Thirty-nine varieties of cotton were tested, the most productive being Bancroft Herlong. Special nitrogen, phosphoric acid, and potash tests failed to give clear indications as to the needs of the cotton crop on the soil of the station.

Varieties (pp. 664–666, 676–678).—The yields of the 39 varieties tested ranged between 1,055 and 393 pounds of lint cotton per acre. The tabulated data include yields of all varieties, percentages of lint, and percentages of crop picked at different times. The earliest maturing varieties, in order of earliness, were Hunnicutt, Smith Standard, Bolivar County, Coltharp Eureka, Roe Early, Cochran Short Limbed Prolific, Early Carolina, King Improved, Okra, Matthew Long Staple, and Welborn Pet.

Peterkin Improved gave the highest per cent of lint, 36.1 per cent; Allen Silk the lowest, 28.2 per cent. The classification and valuation of the staples of all varieties tested are given.

Fertilizer tests (pp. 667–669).—These included special nitrogen, phosphoric acid, and potash experiments in which various forms and amounts of nitrogenous, phosphatic, and potash fertilizers were used in addition to a basal fertilizer.

Late planting and imperfect stands influenced the yields. The results were not conclusive as to the kind and amount of fertilizers required. Generally speaking the fertilizers were profitably used, the average of the unfertilized plats in the three experiments being 1,654 pounds of seed cotton per acre, while the average of all fertilized plats was over 2,000 pounds.

Forage crops, D. N. BARROW, (*Louisiana Stas. Bul. No. 22, 2d ser., pp. 671–673*).—Large African millet, pearl millet, yellow millo maize, white millo maize, Egyptian wheat, Kaffir corn, Jerusalem corn, Egyptian rice corn, and beggar weed (*Desmodium molle*) were successfully grown. Early amber sorghum was also planted. Stock were especially fond of *Desmodium molle* and ate it in preference to all other forage. Giant and Russian sunflowers were grown successfully, and the heads of the latter were especially large. The African ground pea, bearing its pods underground, was found inferior both to chufas and peanuts. Soja beans were a failure. The Conch pea gave a larger growth of vines than the Whippoorwill, Black-eye, Unknown, and Clay varieties.

One-fifth acre plats of alfalfa, bur clover, red clover, scarlet clover, Kentucky blue grass, rescue grass, tall meadow oat grass, orchard grass, Italian rye grass, and English rye grass have been planted.

Field experiments with grains, W. M. HAYS (*North Dakota Sta. Bul. No. 10, May, 1893, pp, 3–26, 50–68*).

Synopsis.—The experiments with wheat consisted of the following: Variety tests; crossing and selecting wheat for seed; thickness of seeding, in which the best

yield resulted from using $5\frac{1}{2}$ pecks of seed per acre; preparation of land; methods of sowing, in which the press drill gave a larger yield than the hoe drill and broadcasting; and rotation experiments. The experiments with oats consisted of a variety test, a test of methods of preparing land, and an experiment to determine the proper quantity of seed. Two varieties of barley were compared.

Variety tests of wheat (pp. 3–16).—One hundred and forty plats were used in a test of varieties of spring wheat. No better variety was found than the generally grown Fife and Blue Stem. These two varieties are discussed at length.

Crossing and selecting wheat for seed (pp. 16–24).—In order to artificially cross valuable kinds of wheat, several varieties were planted with only one plant in a hill. One-half of each kind of wheat was planted twelve days later than the other half, so as to supply an abundance of pollen as needed at different dates. This precaution was found to be unnecessary, as the spikes of a wheat plant that is given plenty of room do not ripen simultaneously, but at intervals. By using as one of the parent plants the Haynes Blue Stem variety, possessing a characteristic hairy chaff, the author believed that he was able to determine whether crosses had been made, or whether self-fertilization had occurred.

From about 2,000 flowers pollenated, 101 grains of wheat were secured for further trial.

Plants grown in 1891 from the seed of 1890, which was the result of crosses between the Fife and Haynes Blue Stem, gave the following results: In four out of nine cases where Blue Stem was used as the male, the resulting cross had the hairy chaff of the male parent. Four out of five plants where Fife pollen was used had the smooth chaff of the male parent; the fifth showed only a partial hairy covering of the chaff.

Single plants of wheat were grown in hills 12 by 18 inches apart, in order to select seed from plants developed under the most favorable conditions. The tabulated results show the weight of grain produced by the best ten plants of each variety, the number of heads per plant, length of heads, height of plants, relative earliness, and liability of grain to shatter.

Thickness of seeding wheat and oats (pp. 25,26).—With a shoe drill spring wheat was sown at the rate of 2, 3, $3\frac{1}{2}$, 4, $4\frac{1}{2}$, 5, $5\frac{1}{2}$, and 6 pecks per acre. The smallest yield resulted from the use of 4 pecks of seed, and the largest from $5\frac{1}{2}$ pecks. Four pecks per acre were sown in drills 6 inches apart; on another plat the same quantity was used, sowing 2 pecks one way and 2 pecks crosswise; on a third plat 4 pecks were sown in drills 3 inches apart. The slight difference in the yields was in favor of sowing in one direction in drills 6 inches apart.

Oats were sown at the rate of 4, 5, 6, 7, 8, 9, 10, 11, and 12 pecks per acre. The variations in the yields were small, all the figures from 6 to 12 giving somewhat better results than either smaller or larger quantities.

Varieties of oats and barley (pp. 54, 55).—The yields of 7 varieties of oats and of 2 varieties of barley are tabulated.

Preparation of land for wheat and oats (pp. 55–63).—At Eldridge, North Dakota, spring wheat was grown on fall-plowed land; on spring-plowed land; on wheat stubble, simply well-worked with a disk harrow before sowing; and on unprepared stubble land. Oats were also grown on plats prepared as above. With both grains the results were in favor of spring plowing.

A popular discussion of the practice of the best wheat-growers is given.

Rotation experiments (pp. 50–54).—Twenty-nine plats, each 1 acre in area, have been laid off for a test of different rotations. Wheat enters into all these rotations; the other crops to be used are corn, timothy, field peas, millet, rape, mangel-wurzels, clover, barley, rye, potatoes, and flax. The yields of many of the plats in 1892 and a schedule of crops to be grown on every plat from 1892 to 1900, inclusive, are given. The land used for this test is believed to be remarkably uniform.

Methods of sowing wheat (pp. 63–68).—At Power, North Dakota, wheat was broadcasted at the rate of 5 pecks per acre and sown at the rate of 4 pecks per acre with a hoe drill and a press-drill. The yields of wheat per acre were as follows: From broadcasting, 8.5 bushels; from the hoe drill, 8.6 bushels; and from the press drill, 10.5 bushels.

Several styles of drills and broadcast seeders are discussed.

Experiments with varieties of millet, flax, fodder corn, and field peas, W. M. HAYS (*North Dakota Sta. Bul. No. 10, May, 1893, pp. 27–44*).—Broom-corn millet (*Panicum miliaceum*) is recommended both for hay and for grain. Belgian flax was successfully grown at Fargo and at Power in 1892. The yields and descriptions of 28 varieties of corn and of 24 varieties of field peas are tabulated. Experiments with peas conducted in Dakota, and previously in Minnesota, led the author to believe that a larger yield of peas than of wheat could be obtained on sandy land. The pressing need for a pea harvester which would gather the peas without shelling them is mentioned.

Sowing oats with peas, W. M. HAYS (*North Dakota Sta. Bul. No. 10, May, 1893, pp. 44–47*).—Oats and peas were sown alone and in mixtures variously proportioned. Oats alone produced the greatest weight of grain per acre, peas nearly as much. The mixtures yielded less grain than peas and oats separately. When a mixture was used, the best proportion was found to be 2 bushels of oats with one-half bushel of peas per acre.

Experiments with oats, R. J. REDDING (*Georgia Sta. Bul. No. 21, Aug., 1893, pp. 48–50*).—*Fertilizer tests.*—Four plats of fall-sown oats were unmanured, 4 received 200 pounds of superphosphate, and 200 of cotton-seed meal per acre; 4 received 200 pounds of superphosphate and 400 of cotton-seed meal; 4 received a complete fertilizer consisting of 200 pounds of superphosphate, 50 of muriate of potash, and 400 of

cotton-seed meal; and 4 received a complete fertilizer consisting of 200 pounds of superphosphate, 50 of muriate of potash, and 200 of cotton-seed meal per acre. The unfertilized plats averaged 27.52 bushels of oats per acre; the fertilized plats yielded from 36.72 to 39.80 bushels. The test was unsatisfactory on account of the irregularity in the stand of oats, caused by the frequent hard freezes during the winter of 1892–'93.

To test the relative values of cotton-seed meal and nitrate of soda, 6 plats were sown with oats November 17, 1892. All were manured with the same mineral fertilizers, viz, superphosphate at the rate of 240 pounds per acre and muriate of potash at the rate of 140 pounds. On 3 plats cotton-seed meal was applied at the rate of 920 pounds per acre at the time of sowing.

The other 3 plats received the same amount of nitrogen, half of it in the form of 460 pounds of cotton-seed meal applied at the time of sowing, and half as nitrate of soda applied as a top dressing March 3. The plats fertilized with cotton-seed meal and nitrate of soda averaged 56.90 bushels of oats per acre, and the other plats 49.52 bushels.

Variety test.—Five varieties of oats were tested, the yields ranging from 34.21 bushels to 46.09 bushels per acre. Vitiating conditions rendered the test inconclusive.

Experiments with Irish potatoes, H. A. MORGAN and F. H. BURNETTE (*Louisiana Stas. Bul. No. 22, 2d ser., pp. 704-708*).

Synopsis.—These experiments embraced an inconclusive test of 60 varieties; a fertilizer test on the first and second crops, in which the use of fertilizers was generally profitable; methods of planting; distance in the drill and number of eyes for planting. Planting on a level gave better results than on ridges or in trenches. A distance of 8 inches in the drill afforded the largest yield. When large tubers were planted the crop was greater than when small tubers or cuttings were used.

Varieties (p. 704).—The results gave no conclusive information as to the best varieties, and the yields of only 4 of the 60 varieties tested are recorded.

Fertilizer tests (pp. 705, 706).—On the first and second crops of potatoes 1,000 pounds of cotton-seed meal, 300 pounds of acid phosphate, and 100 pounds of sulphate of potash were applied per acre, separately and in combination. Except where potash was applied alone the fertilizers increased the yields. In both crops cotton-seed meal alone and acid phosphate alone gave larger yields than a complete fertilizer. The unfertilized plat of the first crop yielded 228.99 bushels per acre. The yield with fertilizers varied between 223.41 and 346.30 bushels per acre.

The fall crop on the unfertilized plat yielded 81.07 bushels per acre. The fertilized plats gave from 77.44 to 118.63 bushels per acre. Fourteen hundred pounds of a "complete fertilizer" per acre gave slightly better results when applied at three different times than when applied all at once, the yields being, respectively, 285.07 and 259.44 bushels. The same fertilizer was applied to potatoes grown by the Rural method, and

the yield was 509.92 bushels per acre. Of this large yield only 3.47 bushels were small potatoes.

Methods of planting potatoes (pp. 705–706).—The following table gives the yields from planting potatoes on a level, on ridges, and by the Rural method:

Yields per acre from planting potatoes by different methods.

Method of planting.	Yield of marketable potatoes.	Yield of small potatoes.	Total yield.
	Bushels.	*Bushels.*	*Bushels.*
On the level	381.00	27.92	408.09
Usual ridge system	201.27	27.72	228.99
Usual ridge system (hilled)	242.00	23.26	265.26
Rural system, with pine straw	321.11	13.97	335.08
Rural system, with long hay	339.73	9.30	349.03

The "Rural system" consists in cleaning out a furrow after the land is prepared with a plow to the depth of 6 inches. These furrows are made 3 feet apart. Plant the potatoes in bottom of furrow, and over these place about 2 inches of fine soil, upon which may be scattered the fertilizers, then lay in the furrow straw or hay about 2 inches deep (usually cut into pieces 2–4 inches long), then the furrow is completely filled in and rounded up.

Distance experiments (p. 706).—Potatoes were planted 4, 8, 12, 16, and 20 inches apart in the drill. The distance between rows is not stated. The largest yield, 412.06 bushels, was afforded by a distance of 8 inches in the drill. The authors recommend planting 12 inches in the drill.

Size of seed (p. 707).—The following table gives the yields secured when large and small potatoes and cuttings of one, two, three, and four eyes were planted:

Yields per acre from whole potatoes and cuttings.

Number of eyes to plant.	Yield of marketable potatoes.	Yield of small potatoes.	Total yield.
	Bushels.	*Bushels.*	*Bushels.*
One eye	272.25	24.43	296.68
Two eyes	293.19	38.40	331.59
Three eyes	248.98	41.48	290.86
Four eyes	205.93	31.41	237.34
Whole tubers, small size	289.70	41.80	331.50
Whole tubers, large size	337.40	70.97	408.37

Compilations of experiments made at thirteen stations to determine the proper amounts of seed potatoes, P. M. HARWOOD and P. G. HOLDEN (*Michigan Sta. Bul. No. 93, pp. 53*).—Tabulated data and notes on experiments made at thirteen stations.

The general conclusion from this bulletin is that the potato-growers of Michigan do not plant enough seed. Experiments go to show that for ordinary distances the half potato gives better results than any smaller amount. For weak growing varieties, or varieties having small tubers, even a larger amount of seed will be found more profitable.

A careful investigation shows clearly that—

(1) An increase in seed within ordinary limits produces a marked increase both in total yield and marketable yield.

(2) An increase in seed from one eye up to the half potato produces an increase in the net value of the crop. But the increased yield from the whole potato over the half potato is not sufficient to cover the cost of the greater amount of seed.

A comparison of the half potato with the two eyes shows that—

(1) For total yield (large and small) of 95 experiments 76 are in favor of the half potato and 19 in favor of the two eyes.

(2) For marketable yield (total less small) of 73 experiments 58 are in favor of the half potato and 15 in favor of the two eyes.

(3) For net marketable yield (marketable less amount of seed) of 30 experiments 23 are in favor of the half potato and 7 are in favor of the two eyes.

(4) For net value of crop (value of crop less value of seed) of 30 experiments 22 are in favor of the half potato and 8 in favor of two eyes.

A comparison of the whole potato with the half potato shows that—

(1) For the total yield (large and small) of 54 experiments 46 were in favor of the whole potato and 8 in favor of the half potato.

(2) For the marketable potato of 42 experiments 36 were in favor of the whole potato and 6 in favor of the half potato.

(3) For the net marketable above seed of 13 experiments 7 are in favor of the whole potato and 6 in favor of the half potato.

(4) For the net value of crop (value of marketable less value of seed planted) of 12 experiments 7 are in favor of the whole potato and 5 in favor of the half potato.

The conclusions given above are based on the hitherto unpublished results of experiments at the Michigan Station and on published results of the following stations: Georgia, Bul. No. 17 (E. S. R., vol. III, p. 693); Indiana, Bul. No. 42 (E. S. R., vol. IV, p. 466); Kentucky, Bul. No. 16 (O. E. S. Bul. No. 2, part II, p. 41), Bul. No. 22 (E. S. R., vol. I, p. 219); Louisiana, Bul. No. 4, 2d ser. (E. S. R., vol. II, p. 566); Maryland, Bul. No. 2 (O. E. S. Bul. No. 2, part II, p. 71), Report for 1890 (E. S. R., vol. II, p. 348); Massachusetts State, Report for 1884, Report for 1885; Michigan, Bul. No. 46 (E. S. R., vol. I, p. 86), Bul. No. 85 (E. S. R. vol. III, p. 872); Nevada, Bul. No. 14 (E. S. R., vol. III, p. 802); New York State, Report for 1882, Report for 1883, Report for 1889 (E. S. R., vol. II, p. 595), Report for 1890 (E. S. R., vol. III, p. 404); Ohio, Report for 1887; Tennessee, Bul., vol. III, No. 1 (E. S. R., vol. II, p. 71); Utah, Bul. No. 5 (E. S. R., vol. II, p. 664); Wisconsin, Bul. No. 22 (E. S. R., vol. II, p. 30).

The results of experiments by E. S. Carman, published in New Potato Culture, are also used. Mr. Carman, by planting a whole potato, with all eyes but one peeled off, every foot in trenches 3 feet apart, fertilizing liberally and cultivating flat, secured a yield at the rate of 806.66 bushels per acre.

Experiments at the Michigan Station to determine the proper amounts of seed potatoes, P. M. HARWOOD and P. G. HOLDEN (*Michigan Sta. Bul. No. 93, Apr., 1893, pp. 7–15*).

Synopsis.—In experiments in 1891 with Burbank and Pearl of Savoy varieties the total and marketable yields increased with the size of the piece planted, from

one eye to the whole potato. The largest net value (value of marketable potatoes less value of seed) with the Burbank was from using half potatoes; with Pearl of Savoy, from using whole potatoes.

With Rural New Yorker No. 2 the largest total yield, marketable yield, and net value of crop resulted in 1891 from using two eyes for seed; in 1892 from using whole potatoes.

In 1892, with Early Ohio and Rural New Yorker No. 2, the total yield increased with the size of the piece planted. Generally the yield of small potatoes increased with the size of the piece planted. Cuttings from large potatoes gave better results than cuttings from small potatoes.

In computing the net value of the crop 50 cents per bushel was used as the price of seed and 44 cents as the price of the large potatoes of the crop. The small potatoes were not valued.

In 1891 the Burbank was planted in hills 33 inches apart each way. One plat was mulched, another was cultivated in the usual way, and a third had mulch applied in the hill. The following table gives the average results:

Yields per acre from planting single eyes, quarters, halves, and whole potatoes.

Seed.	Total yield.	Yield of small potatoes.	Yield of large potatoes.	Amount of seed planted.	Net yield, large potatoes less seed.	Value of large potatoes.	Cost of seed.	Net value of large potatoes,
Burbank.	*Bushels*	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*			
One eye	88	10	78	2.7	153	$34.32	$1.35	$32.97
Quarter potato	181	21	160	6.0	154	70.40	3.00	67.40
Half potato	203	30	173	12.0	161	76.12	6.00	70.12
Whole potato	212	29	183	24.0	159	80.52	12.00	68.52

Pearl of Savoy and Rural New Yorker No. 2 were planted in hills and drills 33 inches apart. In the hills two pieces were placed; in the drills one piece every 16½ inches. The following table gives the average results:

Yields from planting single eyes, two eyes, halves, and whole potatoes.

Seed.	Total yield.	Yield of small potatoes.	Yield of large potatoes.	Amount of seed planted.	Net yield, large potatoes, less seed.	Value of large potatoes.	Cost of seed.	Net value of large potatoes.
Pearl of Savoy.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*			
One eye	72	11	61	5.4	55.6	$26.84	$2.70	$24.14
Two eyes	85	3	82	10.8	71.2	36.08	5.40	30.68
Half potato	107	19	88	24.0	64.0	38.72	12.00	26.72
Whole potato	173	35	138	48.0	90.0	60.72	24.00	36.72
Rural New Yorker No. 2.								
One eye	229	8	221	5.4	215.6	97.24	2.70	94.54
Two eyes	272	8	264	10.8	253.2	116.16	5.40	110.76
Half potato	259	11	248	24.0	224.0	109.12	12.00	97.12
Whole potato	264	24	240	48.0	192.0	105.60	24.00	81.60

In 1892 Early Ohio and Rural New Yorker No. 2 were planted in

hills and drills, as in 1891. The following table gives the average results:

Yield of single eyes, two eyes, halves, and whole potatoes.

Seed.	Total yield.	Yield of small potatoes.	Yield of large potatoes.	Amount of seed planted.	Net yield, large potatoes less seed.	Value of large potatoes.	Cost of seed.	Net value of large potatoes.
Early Ohio.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*			
One eye	130	41	89	5.4	84	$39.16	$2.70	$36.46
Two eyes	173	44	129	10.8	118	56.76	5.40	51.36
Half potato	227	68	159	24.0	135	69.96	12.00	57.96
Whole potato	273	91	182	48.0	134	80.08	24.00	56.08
Rural New Yorker No. 2.								
One eye	239	51	188	5.4	183	82.72	2.70	80.02
Two eyes	242	84	158	10.8	147	69.52	5.40	64.12
Half potato	325	106	219	24.0	195	96.36	12.00	84.36
Whole potato	375	112	263	48.0	215	115.72	24.00	91.72

In these experiments the plats planted with smaller amounts of seed showed many vacant hills in a dry season. The larger amounts of seed gave a more vigorous growth of vines and an earlier crop. The crop from whole potatoes ripened from five to ten days earlier than the crop on the plats planted with single eyes.

With the varieties Empire State, Early Mayflower, and Rural New Yorker No. 2 the value for seed of cuttings from large and from small potatoes was investigated. In every instance the total yield, yield of large potatoes, and net value of crop was greater when the cuttings were from large tubers.

Experiments with potatoes, P. M. HARWOOD (*Michigan Sta. Bul. No. 95, Apr., 1893, pp. 20*).

Synopsis.—This bulletin contains accounts of experiments on (1) hills *vs.* drills, resulting in favor of drills; (2) shallow *vs.* deep culture, resulting in favor of the latter; (3) depth of planting; (4) mulching *vs.* cultivation, in which the yield was slightly in favor of cultivation; and (5) 45 varieties of potatoes grown in 1891 and 49 in 1892.

Hills vs. drills (pp. 5, 6).—In 1892, 24 experiments were made on this subject and 2 varieties were used. Equal amounts of seed were used for equal areas, and each potato was cut into four pieces. The Early Ohio gave an average of 207 bushels per acre in drills and 195 in hills; the Rural New Yorker No. 2 yielded 310 bushels in drills and 281 bushels in hills. In a similar experiment in 1891 the results were also in favor of drills.

Shallow vs. deep culture, and depth of planting (pp. 7–12).—On these questions 45 experiments were conducted. The ground was a sandy loam. The potatoes were planted at depths of 2, 3, 4, 5, and 6 inches. The cultivator when intended for shallow culture was set at a depth of 1½ inches and for deep culture at 5 inches. In ripening, the plats planted 2 and 3 inches deep were slightly in advance of the others.

The average total yield for shallow culture was 263 bushels per acre and for deep culture 290 bushels. Deep culture also gave the largest yield of marketable potatoes and the smallest yield of sunburned and small potatoes.

For planting potatoes 3 inches proved the best depth as far as total yield was concerned. The yield of those planted 2 inches deep was 275 bushels per acre; 3 inches deep, 298 bushels; 4 inches deep, 279 bushels; 5 inches deep, 273 bushels, and 6 inches deep, 238 bushels. The marketable yield was practically the same for those planted 4, 5, and 6 inches deep; slightly less for those 3 inches deep, and still less for those at a depth of 2 inches.

Mulching vs. cultivation (pp. 13–16).—In an experiment in 1891 the yield of potatoes grown under a mulch of straw was 112.9 bushels per acre; when the mulch was applied in the hill the yield was 155.2 bushels. The yield from cultivation without mulch was 168.3 bushels.

In an experiment in 1892, 2 varieties were used to compare mulching with cultivation. Early Ohio mulched yielded 167 bushels per acre; cultivated, 199 bushels. The Rural New Yorker No. 2 when mulched yielded 252 bushels; when cultivated, 385 bushels. The cost of cultivation was less than the cost of mulching, and the profit with both varieties was in favor of cultivation. In the summer of 1892, however, there was a large amount of rain and the straw used as a mulch was not free from grain, so that oats came up on most of the plats. Both of these conditions were, of course, against the mulched plats.

Varieties (pp. 17–20).—In 1891, 45 varieties were tested, and in 1892 49 varieties. In both years the yields of different varieties varied widely, the extremes in 1892 being 304 bushels per acre for the Summit and 81 bushels for the Rochester Favorite.

The sugar beet, J. H. SHEPARD (*South Dakota Sta. Bul. No. 34, Apr., 1893, pp. 47–76*).

Synopsis.—Home-grown beet seed produced beets of a high quality. Trials made by farmers in many parts of South Dakota indicate that nearly every part of the State is capable of raising beets well adapted to sugar manufacture. Analyses of 158 samples of beets are given. * * *

This is a continuation of work reported in Bulletin No. 27 of the station (E. S. R., vol. III, p. 889). From selected mother beets which seeded in 1891 seeds were saved and planted in 1892. The analyses of mother beets were made after storing in the barn cellar till May, 1891. Three beets of the Klein Wanzleben variety then showed, respectively, 15.7, 17.4, and 15.6 per cent of sugar. Beets from this seed analyzed in August, 1892, gave 18.7 per cent of sugar. Two mother beets of Pajaro Valley variety gave 15.31 and 15.51 per cent of sugar; the progeny of the same showed 15.5 per cent of sugar. Two Simon Legrand mother beets gave 15.11 and 15.61 per cent sugar; their progeny gave 18.2 and 18.1 per cent.

Imported seed was distributed to farmers throughout the State.

Notes and tabulated data on culture and the results of analyses are reported for 158 samples of beets grown in different parts of the State.

Analysis gave the following results:

Per cent of sugar in the beet:	Samples.
Under 12	27
Between 12 and 13	13
Between 13 and 14	26
Between 14 and 15	34
Between 15 and 16	28
Between 16 and 17	13
Between 17 and 18	10
Between 18 and 19	6
Over 20	1

The work with sugar beets, which has extended over four years, will be discontinued.

Field experiments with wheat, W. C. LATTA (*Indiana Sta. Bul. No. 45, Aug., 1893, pp. 49–62*).

Synopsis.—A continuation of the work recorded in Bulletin No. 41 of the station (E. S. R., vol. IV, p. 340). The experiments are classed under the following heads: (1) Test of varieties; (2) quantity of seed per acre; (3) early and late sowing; (4) rotation *vs.* continuous grain cropping; (5) commercial fertilizers and horse manure; (6) mowing wheat in spring, and (7) early *vs.* late harvesting. The average results in these lines favor Velvet Chaff (brown bearded), Michigan Amber, Jones Winter Fife, and Early Red Clawson varieties; 6 to 8 pecks of seed per acre; sowing about September 20 rather than later, and rotation of grain and grass. In 1893 commercial fertilizers were unprofitable, while stable manure yielded a slight profit. Mowing wheat in the spring materially reduced the yield of grain and straw. The yield of wheat was not appreciably affected by the stage in which it was harvested.

Test of varieties (pp. 49–54).—Tabulated data are given for 35 varieties of wheat tested in 1893, with the average yields of 6 varieties during from one to ten years. The varieties recommended by the author are Velvet Chaff (brown bearded), Michigan Amber, Jones Winter Fife, and Early Red Clawson. All were seriously injured by rust.

Quantity of seed per acre (p. 55).—Tabulated data are given for the yields of wheat seeded at rates varying from 2 to 8 pecks per acre during nine years (1885–'93). The average yields for the nine years were from 22.07 to 30.35 bushels per acre, increasing with the increased thickness of seed. The increase from sowing more than 6 pecks was relatively small.

Early and late sowing (p. 55).—Tabulated data are given for the yield of wheat sown in five years (1889–'93) at different dates from September 18 to October 18. The average results strongly favor the September sowings. The falling off in yield increased in a marked degree toward the close of the season.

Rotation vs. continuous grain cropping (p. 56).—The average yields in bushels per acre of all the wheat plats of each series for seven years

(1887-'93) were as follows: Grass and grain 21.61, grain alone 15.89, or a gain from rotation of 5.72 bushels per acre.

Commercial fertilizers and horse manure (pp. 57-59).—Notes and tabulated data are given for an experiment made during four years. The financial results in 1893 were in favor of horse manure, while the commercial fertilizers resulted in loss. The average results of the four years' experiment are given in the following table:

Average yield of wheat per acre during four years and financial results.

Fertilizers.	Amount.	Average yield.		Increased yield.		Net profit or loss.
		Grain.	Straw.	Grain.	Straw.	
	Lbs.	*Bush.*	*Lbs.*	*Bush.*	*Lbs.*	
None		20.89	1,971			
Dissolved bone black	138					
Sulphate of ammonia	196	25.26	2,671	5.17	803	*—$6.02
Muriate of potash	53					
Dissolved bone black	104					
Sulphate of ammonia	112	24.49	2,659	4.40	791	—2.71
Muriate of potash	40					
None		19.29	1,765			
Horse manure	8,875	24.75	2,753	4.98	785	0.22
Horse manure	6,975	24.51	1,826	4.74	—142	—0.38
None		20.26	2,172			

* The minus sign (—) indicates a loss.

Mowing wheat in the spring (p. 59).—Notes and tabulated data on an experiment in which wheat on 2 plats was mown April 28 when the wheat was about 6 inches high. The growth of wheat in this year, as in the preceding year, was retarded and the yields of grain and straw were considerably reduced.

Early vs. late harvesting (pp. 60, 61).—The first cutting in 1893 was made June 27, when the bulk of the crop had passed into the dough state. Four other cuttings were made at intervals of two days. The yield of wheat varied but slightly between the very early cutting and the very late cutting. Analyses were made to determine the albuminoid and amide nitrogen in wheat cut at different dates. The results showed very slight changes in the form or per cent of nitrogen present. The prevalence of rust rendered this experiment inconclusive.

Smut (pp. 61, 62).—Brief notes are given as to the means of decreasing the amount of loose smut and preventing the appearance of stinking smut.

Forms of nitrogen for wheat, H. A. HUSTON (*Indiana Sta. Bul. No. 45, Aug., 1893, pp. 63-65*).—Notes and tabulated data for an experiment on hundredth-acre plats in continuation of one reported in Bulletin No. 41 of the station (E. S. R., vol. IV, p. 342). Nitrate of soda, dried blood, sulphate of ammonia, rotted stable manure, and muck were applied in the fall or spring, or in both seasons. As in 1892, sulphate of ammonia gave the largest increase. The second largest increase was from nitrate of soda, and the third from dried blood, while manure and muck gave yields less than the adjoining unfertilized plats. Analyses

of grain from each plat show that the amount of nitrogen varied very little. The results of this year are considered as abnormal and due to injury from rust, which interfered with the normal ripening of the grain.

HORTICULTURE.

Experiments with sweet potatoes, H. A. MORGAN and F. H. BURNETTE (*Louisiana Stas. Bul. No. 22, 2d ser., pp. 709–713*).

Synopsis.—These embrace tests of 23 varieties; an inconclusive fertilizer test; planting in trenches, on a level, and on ridges; distance of planting; planting slips of different length; planting slips taken from different portions of the vine; and pinching, cutting, and moving the vines. The yield increased with the height of the ridges. In the distance experiments the largest yield was secured by planting the slips every 12 inches in the drill. Slips from the terminal end of the vine and 16 to 22 inches long were most productive. Both cutting and moving the vines reduced the crop.

Varieties (pp. 709, 710).—Of the 23 varieties tested Hayman was most productive, yielding 635 bushels per acre, 60 pounds being allowed to the bushel. It was followed by Norton, Southern Queen, and Barbado in the order named. Of these Barbado is the only one classified with the cut-leaf or table varieties.

Fertilizer experiments (p. 710).—A fertilizer test occupied 13 plats, of which 2 plats were unfertilized. Nitrate of soda at the rate of 466$\frac{2}{3}$ pounds per acre, sulphate of potash at the rate of 100 pounds, acid phosphate at the rate of 300 pounds, and cotton-seed meal at the rate of 1,000 pounds per acre were applied separately and in combination. The season was wet and favorable for the production of vines. The fertilizers did not greatly increase the yield.

Methods of planting (p. 711).—The following table gives the yields in bushels per acre of potatoes grown on ridges of different heights, on a level, and in trenches:

Yield of sweet potatoes from ridges of different heights.

Method of planting.	Yield of marketable potatoes.	Yield of small potatoes.	Total yield.
	Bushels.	*Bushels.*	*Bushels.*
In trench with pine straw, buried	160.54	8.72	169.26
On the level	153.56	17.45	171.01
On ridge 4 inches high	143.09	13.96	157.05
On ridge 8 inches high	171.01	13.96	184.97
On ridge 12 inches high	212.89	12.21	225.10
On ridge 16 inches high	219.87	15.70	235.57
On ridge 20 inches high	331.55	10.47	342.02

Distance experiments (p. 711).—The following table gives the total yield in bushels per acre and yield of marketable and small sweet potatoes when the slips were planted at different distances:

Yield of sweet potatoes from slips planted at different distances.

Distance in the row.	Yield of marketable potatoes.	Yield of small potatoes.	Total yield.
	Bushels.	*Bushels.*	*Bushels.*
Eight inches	328.06	10.47	338.53
Twelve inches	247.79	10.47	258.26
Fifteen inches	279.20	6.98	286.18
Eighteen inches	216.38	10.47	226.85
Slips in pairs, 8 inches	321.08	13.96	335.04
Slips in pairs, 12 inches	349.00	10.47	359.47
Slips in pairs, 15 inches	279.20	10.47	289.67
Slips in pairs, 18 inches	272.22	10.47	282.69
Vines all along the row, tips out every 15 inches	237.32	6.98	244.30

The distance between the rows is not given. In 1891 a distance of 15 inches in the drill was best, and this is the distance which the authors recommend.

Length of slips (p. 712).—Long slips were best, as shown by the following table, which gives the yields in bushels per acre:

Yield of sweet potatoes from slips of different lengths.

Length of slips.	Yield of marketable potatoes.	Yield of small potatoes.	Total yield.
	Bushels.	*Bushels.*	*Bushels.*
Four inches long	167.52	15.70	183.22
Eight inches long	153.56	20.94	174.50
Twelve inches long	167.52	13.96	181.48
Sixteen inches long	240.81	15.70	256.51
Twenty inches long	209.40	19.19	228.59
Twenty-four inches long	307.12	10.47	317.59
Whole vines laid in the row, covered every 15 inches	181.48	17.45	198.93
Whole vines laid in the row, all covered but leaves	216.38	13.96	230.34

Slips from different portions of the vine (p. 712).—The following table indicates that the terminal end of the vine is best for slips:

Yield of sweet potatoes from slips taken from different portions of the vine.

Source of slip.	Yield of marketable potatoes.	Yield of small potatoes.	Total yield.
	Bushels.	*Bushels.*	*Bushels.*
From the terminal end of vine	307.12	13.96	321.08
From the center of the vine	261.75	6.98	268.73
From the butt end of the vine	184.97	13.96	198.93

Pruning the vines (p. 713).—The following table indicates that the yield of sweet potatoes is reduced by pruning the vines, even in a wet season:

Yield of sweet potatoes from pruning vines.

Treatment.	Yield of marketable potatoes.	Yield of small potatoes.	Total yield.
	Bushels.	*Bushels.*	*Bushels.*
Vines pinched weekly to a length of 2 feet	188.46	13.96	202.42
Vines cut to length of 2 feet Sept. 15	195.44	20.94	216.38
Vines cut to length of 2 feet Oct. 15	181.48	10.47	191.95
Vines under ordinary treatment	250.34	6.48	256.82

Moving the vines (p. 713).—Vines undisturbed and allowed to root at will yielded 352.49 bushels of salable and 76.78 bushels of small sweet potatoes. Vines not allowed to become attached yielded 226.85 bushels of marketable and 20.94 bushels of small potatoes. These results, obtained at Baton Rouge in 1891, are quite contrary to results secured in 1891 in other parts of the State.

Experiments with vegetables, H. A. MORGAN and F. H. BURNETTE (*Louisiana Stas. Bul. No. 22, 2d ser., pp. 692–720*).—*Variety tests.*—The following vegetables were tested: Four varieties of asparagus, 14 of beans, 23 of beets, 2 of kale, 2 of Brussels sprouts, 3 of cauliflowers, 37 of cabbages, 10 of carrots, 2 of celery, 11 of cucumbers, 3 of eggplant, 9 of lettuce, 2 of mustard, 1 of rouquette, 16 of muskmelons, 24 of watermelons, 3 of okra, 24 of peas, 11 of pepper, 23 of radishes, 5 of ruta-bagas, 15 of squashes, 41 of early tomatoes, 31 of fall tomatoes, and 12 of turnips. The varieties of sweet corn planted were ruined by the bollworm (*Heliothis armigera*).

Fertilizer tests.—Cotton-seed meal, acid phosphate, sulphate of potash, and nitrate of soda, singly and in combination, were applied to Bristol Late Flat Dutch cabbage. The results showed that phosphoric acid was needed. Nitrate of soda increased the yield and injured the quality of the heads. A single application of a complete fertilizer gave heads of a better quality than the same fertilizer in three applications.

Cotton-seed meal at the rate of 1,000 pounds per acre, acid phosphate at the rate of 300 pounds, and sulphate of potash at the rate of 100 pounds were applied alone and in combination to 6 tomato plants. The largest yield was with a complete fertilizer in three applications.

Transplanting and training tomatoes.—With both spring and fall tomatoes the yield of plants transplanted from pots was greater than when they were from trenches. Spring tomatoes gave larger yields than fall tomatoes.

Training tomatoes on a single stake hastened ripening. The vines allowed to fall upon rests, one on each side of the row, 1½ feet high, gave larger yields than those trained to a single stake or to wire netting. Hilling the plants increased the yield.

The vegetable pear (*Sechium edule*).—This perennial, belonging to the family *Curcubitaceæ*, is called *cayote* in Panama, *chucu* in Brazil, and *chocho* in Jamaica. Its fruit and yam-like tubers are said to be used as food for man and beast in the West Indies.

We have used the fruit cooked much like other cucurbits and regard it quite palatable and worthy of a more extensive cultivation. The fruits become ready for use about the first of November, and may be stored away in barrels in a cool place, where they will keep well all winter.

The following is a record of the production of two plants last season:

Whole crop, 347 fruits. Whole weight, 232 pounds. Average weight, 15.02 ounces.

Fruit trees, small fruits, and grapes, H. A. MORGAN and F. H. BURNETTE (*Louisiana Stas. Bul. No. 22, 2d ser. pp. 679–692*).—The fruits

now under test comprise 40 varieties of apples, 5 of crab apples, 32 of pears, 7 of quinces, 53 of peaches, 6 of almonds, 2 of nectarines, 53 of plums, 7 of cherries, 7 of apricots, 3 of medlars, 5 of mulberries, 14 of persimmons, 39 of figs, 3 of oranges, 2 of pomegranates, 5 of pecans, and 2 of walnuts.

Nurserymen and growers are warned as "to the danger of introducing a very serious insect enemy, the peach aphis (*Aphis persicæ-niger*) which is now doing so much damage in the States of Maryland, Delaware, New Jersey, and Virginia. Like discretion should be exercised in introducing plants from districts infested with yellows."

Seventy-nine varieties of strawberries, 8 of raspberries, 6 of blackberries, 4 of dewberries, 1 of wineberry, 2 of Juneberries, 3 of gooseberries, and 6 of currants were grown.

The vineyard consists of 100 varieties of grapes, which will be reported on later. Brief notes are given on the use of two common fungicides.

Analyses of fruits, etc. (*Massachusetts State Sta. Report for 1892, pp. 324–333*).—A compilation of analyses of miscellaneous fruits and sugar-producing plants.

General objects and plans of the viticultural work at California Station, E. W. HILGARD (*California Sta. Report of the Viticultural Work during the seasons 1887–'89, pp. 13–27*).—Under this head are discussed the condition of viticultural work in California, with special reference to the quantities of grapes used in laboratory work; also preservative processes and plans for future work.

Results of field experiments and laboratory investigations in viticulture, L. PAPARELLI (*California Sta. Report of the Viticultural Work during the seasons 1887–'89, pp. 31–274*).—Field results obtained in different portions of the State and notes on the character of wine produced by a number of varieties of grapes are given. Of the varieties investigated, 12 were of the Bordeaux or Claret type, 6 of the Burgundy type, 7 of the Italian type, 12 of the Southern French type, 5 of the Austrian and Hungarian type, and 6 of the Port type.

The Italian type is especially recommended.

The peculiarities that make these grapes very valuable for culture in California, whose climate is so similar to that of Italy, is their remarkably high acidity conjointly with a good proportion of sugar; they are likely also to reach an unusually high percentage of sugar while still maintaining a good proportion of acidity. Besides, they are quite astringent, and yield wines of deep color. In general they produce wines which are in large demand, both in Italian and foreign markets, on account of their remarkably good keeping qualities, their deep color, very pronounced vinosity, and agreeable acidity; by aging, their astringency is reduced, and then they are very delicate, and can be considered as first-class dry wines of as good quality as those of the Bordeaux type. Some of them are also well adapted for the making of white wine, sweet or fortified, and for sparkling wines. The results obtained in Italy with these grapes have been in every respect very satisfactory,

Our experiments in the culture and the vinification of these grapes have confirmed the opinion that among them we have a group which may be relied upon for the making of good dry wines of excellent keeping qualities, under climatic conditions in which those of more northerly origin lose character and fail as dry-wine grapes.

SEEDS.

WALTER H. EVANS, *Editor.*

The impurities of clover seed, F. C. STEWART (*Iowa Sta. Bul. No. 21, pp. 805–814, figs. 55*).

Synopsis.—In sixty-three samples of clover seed grown in Iowa and in other States, impurities averaged 5.74 per cent by weight. Brief notes are given on 35 weeds, the seeds of which were found in clover seed.

Eighty-four samples of clover seed were examined. Of these 57 were grown in Iowa, the others in Ohio, New York, Illinois, Michigan, Minnesota, Missouri, Nebraska, Wisconsin, New Jersey, and Indiana. The percentage of impurities in each sample is tabulated. In one sample the impurities constituted 67 per cent, or about 40 pounds in a bushel. In three samples the impurities fell below 0.3 per cent; the average content of impurities was 5.74 per cent.

The weed seed occurring most frequently was *Setaria viridis*, which was found in 50 samples. Next in frequency of occurrence were *Plantago rugelii*, *Polygonum persicaria*, and *Setaria glauca*, in the order named.

The other weed seeds found in clover seed were as follows, named in order of frequency of occurrence: *Panicum glabrum*, *Chenopodium album*, *Panicum crusgalli*, *P. capillare*, *Ambrosia artemisiæfolia*, *Amarantus albus*, *Rumex crispus*, *R. altissimus*, *Panicum proliferum*, *Rumex acetosella*, *Polygonum acre*, *Brunella vulgaris*, *Polygonum convolvulus*, *Amarantus blitoides*, *Plantago lanceolata*, *Amarantus retroflexus*, *Verbena bracteosa*, *Œnothera biennis*, *Panicum sanguinale*, *Ambrosia psilostachya*, *Polygonum pennsylvanicum*, *Verbena stricta*, *Anthemis cotula*, *Paspalum læve*, *Plantago major*, *Polygonum hydropiper*, *Chrysanthemum leucanthemum*, *Lychnis githago*, *Polygonum aviculare*, *Verbena urticæfolia*, and *Plantago patagonica aristata*.

Brief notes are given on 35 weeds and the seeds of 22 species are figured.

DISEASES OF PLANTS.

WALTER H. EVANS, *Editor.*

Report of the department of vegetable physiology, J. E. HUMPHREY (*Massachusetts State Sta. Report for 1892, pp. 211–247, plates 5*).

Synopsis.—The subjects treated are: (1) Cucumber diseases; (2) a violet disease; (3) the black knot of plum and cherry; (4) grain rusts; (5) powdery mildew of strawberry; (6) powdery mildew of gooseberry; (7) cluster cup of gooseberry; (8) a hazel fungus, and (9) treatment for powdery mildew.

Under diseases of the cucumber the following are described: A sclerotium disease, powdery mildew, downy mildew, damping off, leaf blight, and leaf glaze, with brief notes on other diseases.

The sclerotium disease (*Sclerotinia libertiana*), popularly called "timber rot," is so far confined to winter-grown cucumbers. It makes its appearance in the spring, when the plants are bearing, and is a cause of much loss. It attacks chiefly the stem of the host, sometimes the fruit. The earliest external sign of its presence is the appearance at or near the nodes of dense white mats of mycelium. As the disease progresses, the plant begins to shrink and turn yellow, finally drying up, leaving a withered stem, consisting of the epidermis and vascular bundles only. The interior of the stem is permeated by the mycelium, which produces hard, slender, black bodies, often of considerable size. Sometimes these bodies are developed from the mats of mycelium on the exterior of the stem, but not often. When the young fruits are attacked they become soft and watery, and their surfaces are covered with the white mycelium. The sclerotia are freely developed on the rotten fruits, often seen adhering to their shrunken remains.

The fungus was isolated and studied for some time by cultures, and many facts of its life history ascertained. The "summer spore" stage was carefully studied, and the author thinks the presumption very strong that it possesses a conidial stage of the *Botrytis* type. The specific determination is not made with certainty, but it greatly resembles the form *Botrytis vulgaris*, causing the lettuce rot.

The remedy suggested is the destruction of all infected vines, preventing the formation of sclerotia, by which the fungus is carried from crop to crop. If this is done, no spraying will be found necessary.

The powdery mildew (*Erysiphe cichoracearum*) is described by a recapitulation from the Annual Report of the station for 1891 (E. S. R., vol. IV, p. 48).

The downy mildew (*Plasmopara cubensis*), which was reported in the Annual Report of the station for 1890 (E. S. R., vol. III, p. 160), is again reported from greenhouses, where judicious spraying would probably keep it in check.

The damping off fungus (*Pythium debaryanum*) is reported as particularly troublesome. Experiments show that the fungus may remain a long time in the soil. A previous report on this disease is given in the Annual Report of the station for 1890 (E. S. R., vol III, p. 160).

Leaf blight (*Cladosporium cucumerinum*) is reported on. Plants were observed with roots and stems sound but leaves wilted and watery. The disease spreads rapidly through the greenhouse, destroying the whole plant in two or three days. It is rather erratic in its spread, attacking a plant here and there. Prompt spraying when first noticed will prevent its spread to other plants.

The leaf glaze (*Acremonium* sp.), a bacterial disease, and an anthracnose, due to *Glœosporium* sp., are mentioned and brief notes on them are given.

A violet disease (*Phyllosticta violæ*) has been especially troublesome in some localities. The leaves, when attacked, show numerous circular spots about an eighth of an inch in diameter. As the disease progresses the spots run together, often involving the whole leaf. From parts of the fields where the trouble was most serious a peculiar sickening odor was noted as accompanying it. Some varieties seem more resistant than others, and well-shaded plants suffer least of all. Watering plants with a solution of permanganate of potash, one part in two thousand, or spraying with the more common copper compounds, are advised as best methods of treatment. Plants that have been forced for winter and spring blooming are most susceptible to attack.

The black knot of plum (*Plowrightia morbosa*) is reported upon. The results given in the Annual Report of the station for 1890 (E. S. R., vol. III, p. 160) were confirmed in every particular. Pruning and spraying are advised as preventive remedies, and their use is strongly urged.

Circulars were sent to farmers throughout the State asking for information regarding diseases of crops. But few replies were received, and from them it seems that the season of 1892 was unfavorable to the diseases of grains.

Powdery mildew of strawberry (*Sphærotheca castagnei*) was abundant at the station during the past season. The affection shows itself in the curling or inrolling of the leaves. If examined the lower surfaces of the leaves will be found frosted with the scattered mycelium. The author has not observed the perfect spore, but thinks there can be no doubt as to its identity. Its treatment is given under the directions for treating powdery mildews.

The gooseberry mildew (*Sphærotheca mors-uvæ*) is reported on the "Triomphe" gooseberry, a variety hitherto claimed as mildew proof.

The cluster cup of gooseberry (*Æcidium gossulariæ*) has been more than usually abundant during the past season, and has caused a considerable loss of foliage and fruit. Only this one form has been observed; the host of the rust forms has not yet been found. Hand picking of diseased leaves and burning them is advised as a means of preventing its spreading.

A hazel fungus (*Cryptosporella anomala*) is reported as severe upon *Corylus avellana* and as increasing in severity. It is closely related to the black knot of the plum, and should be treated in the same manner. It appears as protuberances with elliptical bases that burst through the bark. Inside of these protuberances the spores are formed. The spores are described, but of the life history of the fungus little is known.

Directions are given for the treatment of powdery mildew both indoors and out. Fumes of sulphur are recommended for greenhouse treatment and flowers of sulphur dusted over the plants for those outdoors. Directions for application are given in detail.

Common fungus diseases, T. A. WILLIAMS (*South Dakota Sta. Bul. No. 35. May, 1893, pp. 79–83*).—Popular descriptions and methods of treatment are given for the following: Apple scab (*Fusicladium dendriticum*), apple twig blight (*Micrococcus amylovorus*), spot disease of plum and cherry (*Cylindrosporium padi*), blight or mildew of plum and cherry (*Podosphæra tridactyla*), black knot of plum (*Plowrightia morbosa*), plum pockets (*Exoacus pruni*), spot diseases of currant (*Septoria ribis* and *Cercospora angulata*), strawberry leaf blight (*Sphærella fragariæ*), and potato scab (*Oöspora scabies*).

FOODS—ANIMAL PRODUCTION.

E. W. ALLEN, *Editor*.

Analyses of foods and feeding stuffs (*Massachusetts State Sta. Report for 1892, pp. 291, 292, 310–323*).—Analyses are given of baking powder, the husk of the coffee berry, the parchment covering of the coffee bean, cider, vinegar, preservaline, exudation from an elm tree, and damaged oats, and a compilation of analyses of salt and of miscellaneous feeding stuffs (both food and fertilizing constituents).

Analyses of fodder articles made at the station in 1892, C. A. GOESSMANN (*Massachusetts State Sta. Report for 1892, pp. 78–91*).—Analyses of green corn fodder, corn stover, corn kernels, corn cobs, sweet corn, corn silage, green vetch and oats, green soja bean, green rye, green Hungarian grass, soja-bean straw, cotton-seed meal, gluten feed, gluten meal, Dick gluten flour, corn meal, corn screenings, corn-germ meal, maize feed, wheat bran, starch feed, oat feed, malt sprouts, ground barley, and ground meat scraps (chicken feed), with reference to food ingredients; and of corn silage, green Hungarian grass, green corn fodder, corn stover, green soja bean, soja-bean straw, cotton-seed meal, and ground meat scraps (chicken feed), with reference to fertilizing ingredients. Analyses of some of these are given in the following table:

Analyses of commercial feeding stuffs.

	Water.	In 100 parts of dry matter.				
		Crude ash.	Crude cellulose.	Crude fat.	Crude protein.	Nitrogen-free extract.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Gluten feed	6.81	1.81	6.39	11.73	28.43	51.64
Buffalo gluten feed	8.82	1.12	6.17	12.86	31.05	48.80
Do	8.97	0.77	5.09	13.46	26.16	54.52
Do	6.33	0.95	5.76	12.99	25.75	54.55
Do	6.82	0.83	4.94	13.03	28.71	52.49
Coon gluten feed	7.87	1.97	1.58	10.48	25.03	60.94
Pope gluten feed	13.98	0.75	1.80	16.34	38.68	42.43
Gluten meal	8.80	0.46	6.10	8.49	18.18	66.77
Dick gluten flour	7.07	0.91	1.69	17.11	33.89	46.40
Corn screenings	11.02	2.39	3.27	4.48	8.29	81.57
Corn-germ meal	7.55	0.87	14.05	12.17	10.81	62.10
Maize feed	8.80	0.65	8.01	6.84	25.69	58.81
Do	8.60	0.92	7.93	7.90	29.40	53.85
Starch feed	10.01	6.58	11.77	5.04	18.06	58.55
Do	10.18	6.65	12.04	4.49	17.05	59.77
Ground meat scraps	3.71	35.61	....	20.31	40.08	....

Determinations of water and dry matter in vetch and oats and in soja beans at different periods of growth are also given.

Analyses of feeding stuffs (*Massachusetts State Sta. Buls. Nos. 48 and 49, June and Aug., 1893, pp. 7 in each*).—Tabulated analyses of hay, rowen, corn fodder, corn silage, corn and soja bean silage, oat and pea silage, cotton-seed hulls, gluten feed, gluten meal, "proteina," cotton-seed meal, old-process linseed meal, dried brewer's grains, pea bran, and hen food.

Compilation of the amount of digestible nutrients consumed daily in the different feeding experiments made at the Massachusetts State Station, J. B. LINDSEY (*Massachusetts State Sta. Report for 1892, pp. 163–167*).—This consists of a statement of the rations fed to milch cows, steers, and lambs each year for a number of years. For comparison Wolff's standards are given.

Discussion on fodder articles and fodder supplies, C. A. GOESSMANN (*Massachusetts State Sta. Report for 1892, pp. 62–77*).—A reprint from Bulletin No. 45 of the station (E. S. R., vol. IV, p. 661).

Shelter of stock, J. W. SANBORN (*Utah Sta. Bul. No. 23, July, 1893, pp. 1–10*).

Synopsis.—Separate trials with steers, pigs, and sheep are reported, and a general summary of previous trials. In the present trials the steers and sheep fed indoors made the best gains and the most economical use of their food. The pigs fed outdoors gained more, but also ate considerably more, making their gain more expensive.

Shelter of cattle (pp. 1–4).—Three lots of 3 steers each, averaging nearly 900 pounds in weight, were fed from December 20 to April 18, one lot in the open air, another in an open shed made of rough boards, and a third in box stalls in the barn. The food was the same for all three lots. Up to January 25 the amount was the same for the three lots, but after that they were fed all they would eat. The average temperature in the barn was 43° F. and in the open air about 28°. From December 20 to January 24 the lot in the shed gained 49 pounds, the lot in the open air 63 pounds, and the lot in the barn 107 pounds. From January 25 to April 18 the lot in the shed gained 277 pounds, the lot in the open air 311 pounds, and the lot in the barn 302 pounds. The total gain during the trial was, therefore, in the following order: Lot in barn 409 pounds, lot in open air 374 pounds, and lot in shed 326 pounds. The food eaten per pound of gain followed the same order and was 16.1, 18.8, and 20.9 pounds, respectively.

The experiment agrees with that of preceding years in showing that a lot in a warm barn, in box stalls, with limited exercise, makes a more economical use of food than a lot in the open air. * * * The total amount of food consumed for the lot in the box stalls was but 18.3 pounds per day for steers weighing slightly over 1,000 pounds apiece. This is but Wolff's estimated food of maintenance, yet the cattle gained over a pound a day on this food. It was, therefore, economically used, and shows either that our native steers are good feeders, or that our food is quite nutritious, or that the German basis is a fallacious one.

Shelter of hogs (pp. 4-6).—Two lots of pigs were fed from December 10 to April 19, one indoors and the other outdoors with a shed to run under. The food consisted of ground barley, ground wheat, and bran. The individual weights of the pigs at the beginning of the trial are not stated. The lot in the open air gained 17 pounds more than the lot in the barn, but consumed 269.5 pounds more food. Hence the lot in the barn made the most economical use of their food.

This trial does not agree with that of the previous year, wherein the sheltered lot required 7 pounds of food for a pound of growth, and the unsheltered lot 6.91 pounds. The lot last year did not have the privilege of running under shelter, but had to lie in the snow as it fell, but slightly assisted by bedding placed in the corner of the lot. It had, however, the side of a close board fence to lie up against and a building on one side.

Shelter of sheep (pp. 7, 8).—Two lots of lambs were fed from December 19 to January 25, one indoors and the other in an open shed. The lot fed indoors gained 290 pounds and the lot fed in the shed 281 pounds. Both lots were fed the same amounts of hay and grain, but the lot fed outdoors ate its food with less waste.

The result agrees with the trial last winter, and is contrary to the usual view held by the public. It has been practically a universal belief that sheep stand cold weather on account of the protecting coat of wool better than either cattle or hogs. I am now satisfied by observation of the two years' trials that such is not the case. It probably would be the case if all the days were perfectly dry, but the moisture that falls upon and saturates the fleece, wetting often to the skin, requires quite prolonged periods for drying out. This requires the heat of the body to accomplish it. Rain affects their vitality more than it does cattle or hogs, whose hair is better calculated to shed moisture, and when this is not accomplished their hair dries out much more quickly and with less influence on the system than is the case with sheep.

General summary (pp. 9, 10).—The author gives a brief summary of trials made by himself at the Utah Station and elsewhere on the advantage of protecting stock from the cold in winter. As a general rule animals sheltered and allowed a moderate amount of exercise gave a better return for the food eaten than those without shelter. In two trials with steers, however, the reverse was true.

Cotton-seed hulls as a food for milch cows (*Georgia Sta. Bul. No. 21, Aug., 1893, pp. 46-48*).—To compare cotton-seed hulls (10 pounds) with sorghum silage (30 pounds), 8 cows were fed for a period of eight days on the one ration, and then changed to the other for eight days longer. Wheat bran, cotton-seed meal, and timothy hay were fed alike with both rations. The two periods were separated by an intermediate period of one week.

The results are not particularly striking, chiefly for the reason that the cows were fairly well sustained by the grain ration of 8 pounds of bran and 3 pounds of cotton-seed meal and 2 pounds of timothy hay. It indicates, however, that 10 pounds of cotton-seed hulls are not equivalent to 30 pounds of sorghum silage. The cows could not be induced to eat more than the 10 pounds of hulls.

Another trial to compare corn silage with cotton-seed hulls, each fed alone, was discontinued after eight days on account of the shrinkage in

milk and in live weight of the cows fed on hulls alone. The lot fed on silage neither gained nor lost in weight, but the milk yield shrunk nearly 19 pounds.

Feeding experiments with milch cows, C. A. GOESSMANN (*Massachusetts State Sta. Report for 1892, pp. 14–45*).—*Winter feeding experiment with milch cows* (pp. 15–32).—A reprint of an experiment to compare silage from dent and sweet corn with corn stover from the same varieties, described in Bulletin No. 42 of the station (E. S. R., vol. IV, p. 176).

Summer feeding experiment with milch cows (pp. 33–45).—This experiment was made to compare various crops for soiling. The trial was with six cows and lasted from May to September, 1892, inclusive. The season was divided into four feeding periods, in which (1) rye, (2) peas and oats, (3) vetch, and (4) fodder corn and serradella were fed, respectively, in connection with about 5 pounds of rowen per head and a constant grain ration. The grain ration consisted of 3 pounds each of wheat bran, gluten feed, and cotton-seed meal. The amount of green fodder fed was governed by the appetites of the animals, and ranged from 16¼ pounds of green rye to 70 pounds of corn fodder and serradella. The feeding of the rye and oats began when they were heading out; of the peas, vetch, and serradella when in bloom; and of the corn fodder when the kernels commenced glazing. The green fodder was discontinued as soon as it neared maturity.

The cows used were, with one exception, from three to five months advanced in the milking period. The average yield of milk at the beginning of the trial was from 10.88 to 13.53 quarts per day. A detailed record for each cow is tabulated, together with analyses of all the feeding stuffs used, with reference to both food and fertilizing ingredients. The principal results are summarized for each period as follows:

Daily averages per animal.

	Total cost of food.	Value of manure (80 per cent obtainable).	Net cost of food.	Average yield of milk per cow.	Average cost of food per quart of milk.
	Cents.	*Cents.*	*Cents.*	*Quarts.*	*Cents.*
Period 1, green rye	16.43	8.21	8.22	9.63	1.71
Period 2, Canada peas and oats	18.16	8.75	9.41	10.39	1.75
Period 3, vetch and oats	19.57	10.02	9.55	9.57	2.04
Period 4, corn fodder and serradella	20.90	9.81	11.09	8.57	2.44

It will be seen that the total and net cost was least for the ration containing green rye. In going from this ration to peas and oats there was an increase in the average daily production of milk. The milk production of the third period, on vetch and oats, was maintained nearly equal to that of the first period. In considering the data for the cost of food per quart of milk it should be remembered that in the last period the majority of the cows were eight months advanced in

the period of lactation. The figures are, therefore, not directly comparable.

The results of our summer feeding experiments are on the whole very satisfactory, as may be seen from the summary of the yield of milk and of the cost of feed consumed per quart of milk produced. They furnish also an additional illustration of the statement that a well regulated system of feeding our dairy stock during the summer secures the most satisfactory results, financially and otherwise.

Feeding experiments with steers, C. A. GOESSMANN (*Massachusetts State Sta. Report for 1892, pp. 92–125*).—Reference to an experiment reported in Bulletin No. 40, and the Annual Report of the station for 1891 (E. S. R., vol. III, p. 162; IV, p. 67), together with a full description of two other experiments.

Second feeding experiment with steers (pp. 95–108).—A reprint from Bulletin No. 44 of station (E. S. R., vol. IV, p. 478).

Third feeding experiment with steers (pp. 109–125).—This trial lasted from October, 1890, to May, 1892, and was divided into three portions, the first winter feeding, the summer pasturing, and the second winter feeding. Three yearling grade shorthorn steers, ranging from 595 to 655 pounds in live weight, were used for the trial.

The food of the first winter, from October 14 to April 20, consisted of wheat bran, and cotton-seed meal, from 2 to 3 pounds each, and meadow hay, barley straw, clover hay, corn silage, and turnips. The gain in live weight during the winter was 198, 244, and 250 pounds, respectively. It is calculated that with dressed beef at 3¾ cents per pound the average daily gain in weight should have been 1.91 pounds in order to prevent a loss from the feeding, even when the value of the manure was taken into account. As a matter of fact the average daily gains were 1.05, 1.29, and 1.32 pounds, or an average for the three steers of 1.22 pounds. Hence the animals were fed at a financial loss.

The steers were pastured from April 27 to November 3 at an expense of 25 cents per head per week. The average daily gain in live weight per animal was 0.57 pound. The gain in weight should have been 1 pound per day in order to pay for the pasturage, leaving out of account the cost of taking the steers to the pasture and back again. The cost of food per pound of gain was 5.6, 6.33, and 7.14 cents, respectively. "Adding to this result the unavoidable falling off in live weight, due to a change in mode of living, it is apparent that pasturing without an additional supply of feed from outside sources is apt to prove an unprofitable delay in the maturing of young steers for the meat market."

During the second winter's feeding, which lasted from November 10 to May 16, the food consisted of from 3 to 4 pounds each of wheat bran and maize feed, or gluten feed, together with hay, corn silage, corn stover, and roots. The total gains made were 252, 275, and 300 pounds, respectively. To cover the net cost of the food required an average gain of 2.45 pounds per head daily. The gains were 1.6, 1.34, and 1.46 pounds per day.

The average daily gain in live weight, taking the entire experiment into considera-

tion, is somewhat higher than that noticed in the second experiment; yet at no period of the trial does the daily increase in live weight at 3¾ cents market cost per pound of live weight equal the entire local market cost of the feed consumed in connection with its production. This result is due in some degree, no doubt, to the contemporary high local market cost of some of the fodder ingredients largely used in the making up of the daily fodder rations.

The results of our experiments in this connection are, as may be noticed from preceding reports, rather more instructive than remunerative. A market cost of 3½ cents per pound of live weight in cases of yearlings, with 3¾ cents per pound of live weight in cases of matured steers, leaves, it will be conceded, but a small margin of cash profits. The largest daily increase in live weight, in case of any diet thus far experimented with, was 0.46 pound per 100 pounds of live weight, with yearlings weighing from 650 to 700 pounds per head; while in case of two-year-old steers, weighing from 1,100 to 1,150 pounds per head, it reached but 0.3 pound for every 100 pounds of their live weight. The highest daily increase in live weight during any feeding period in case of yearlings thus far secured by us amounted to 2.9 pounds per head, and in case of two-year-olds to 3.4 pounds per head. These results represent a market value of live weight gained at local meat market prices of 10.87 cents in case of yearlings and 12.55 cents in case of two-year-old steers. Our results fall behind daily, thus far, about 1 pound of gain in live weight to cover the market cost of the feed consumed for its production; 14 to 15 cents in case of yearlings, 18 to 19 cents in case of two-year-old steers.

The necessity of efficient and cheap fodder rations being quite evident, it seems desirable to try, more generally, fodder crops of a higher nutritive character than the majority of our meadows and pastures furnish at present.

Winter feeding experiments with lambs, C. A. GOESSMANN (*Massachusetts State Sta. Report for 1892, pp. 126–144*).—A reprint from Bulletin No. 43 of the station (E. S. R., vol. IV, p. 356).

Feeding experiments with pigs, C. A. GOESSMANN (*Massachusetts State Sta. Report for 1892, pp. 145–162*).—An account of two experiments in the series carried on at the station during several years. The eighteenth and nineteenth experiments are reported in Bulletin No. 47 of the station (E. S. R., vol. V, p. 74).

Introduction (pp. 145, 146).—The results of fifteen different feeding experiments with young pigs, grades and thoroughbreds, for the meat market, have already been published in our preceding annual reports. The results of two new experiments are reported on the present occasion.

We usually keep, the whole year around, one young pig for every cow in the dairy, to dispose of our skim milk. On the average, five lots of young pigs are prepared for the meat market every two years. The animals are usually bought when from 5 to 6 weeks old, and weigh from 25 to 30 pounds per head. They are fed until they reach a live weight of from 180 to 190 pounds, when they are sold to the butcher.

From 112 to 125 days are usually required to produce the desired live weight. Their daily gain in live weight has been from 1.4 to 1.5 pounds. During spring, summer, and autumn one to two weeks' less time is needed than during the winter season to finish the operation. The shrinkage from live weight to dressed weight varies usually from 18 to 21 per cent.

Our daily supply of skim milk rarely exceeds 5 quarts per head of young pigs. We usually begin feeding from 2 to 3 ounces of corn meal with every quart of skim milk required at the time. As soon as the live weight has reached from 60 to 70 pounds per head we increase the corn meal to 4 ounces per quart of skim milk consumed.

The additional feed subsequently called for has usually been made of either a suitable mixture of several kinds of commercial feed stuffs, as wheat bran and Chicago gluten meal, or dried brewers' grain and gluten meal, or ground barley and Chicago maize feed; or some single feed stuff, as Buffalo gluten feed or Chicago maize feed. The market cost of the various feed stuffs suitable for the purpose largely controls, for obvious reasons, their temporary selection.

During the present year (1892) Chicago maize feed and Buffalo gluten feed have been chosen for our observation. The market cost of the feed consumed per pound of dressed pork produced has varied during past years from 4.3 to 6.4 cents.

The available manurial refuse has amounted to two-fifths of the market cost of the feed consumed. Dressed pork has of late sold at from 6½ to 7½ cents per pound.

Sixteenth feeding experiment with pigs (pp. 146–154).—Six grade Chester White pigs, weighing about 40 pounds each, were fed for about 9 weeks beginning September 12, 1891, on skim milk and potatoes, the potatoes being boiled and mashed and fed at the rate of 1 pound to every quart of skim milk. In 69 days the pigs made an average gain of 46 pounds each, or 0.69 pound per day, at an average cost of 4.95 cents per pound of live weight gained.

They were then fed in separate pens, from December 1 to February 3, on skim milk, barley meal, wheat bran, and maize feed. At the termination of the feeding the pigs were slaughtered. The data for this part of the trial are tabulated for each pig, together with analyses of the materials fed, with reference to both food and fertilizing ingredients.

At the time of killing the pigs weighed from 171 to 194 pounds, live weight. The loss in weight by dressing ranged from 18.38 to 26.04 per cent. The net cost of food per pound of dressed weight gained, assuming 70 per cent of the manurial value to be recovered, ranged from 5.69 to 6.5 cents.

"The high cost of feed per pound of live weight gained in this experiment is due to two causes, namely, low rate of daily increase in live weight during the first half of the time occupied by the experiment, and the high market cost of the ground barley used in large quantities during the second half of the experiment."

Seventeenth feeding experiment with pigs (pp. 155–162).—Six grade Chester White pigs, averaging about 33 pounds each in weight at the beginning of the trial, were fed from March to July, 1892, on a ration of skim milk, corn meal, and gluten feed. The live weight gained during the one hundred and twenty-two days of feeding ranged from 149.5 to 165.75 pounds. The loss in weight by dressing ranged from 16.53 to 26.9 per cent.

"The daily gain in live weight averaged per head 1.56 pounds. The total cost of feed consumed per pound of dressed weight produced averaged 5.8 cents, while the net cost averaged 4.2 cents. The obtainable manurial refuse amounted to two fifths of the market cost of the diet consumed. The dressed pork sold in our local markets at 6½ cents per pound.

Feeding colts, C. F. CURTISS (*Iowa Sta. Bul. No. 21, pp. 768–774*).

Synopsis.—An experiment with six colts to compare ground corn and oats with the same unground. The results showed the larger gain in weight to be from the ground grain. This result confirms that of a similar experiment previously made at the station.

This is a continuation of an experiment on feeding ground and unground grain to colts, described in Bulletin No. 18 of the station (E. S. R., vol. IV, p. 424). The same colts were used as in that experiment, namely, two Percherons, two English Shires, and two French Coaches. The experiment included two periods of forty days each, with an intermediate period of sixteen days. The colts were divided into two equal lots. The food for both lots consisted of oats, corn, bran, linseed meal, and hay. In the first period lot 1 received ground grain and cut hay; lot 2, unground grain and uncut hay. In the second period the lots were reversed. The experiment lasted from February 1 to May 8. In the first period the lot on ground grain gained 149 pounds, and the lot on unground grain 127 pounds. In the second period, the lot on ground grain gained 108 pounds, and the lot on unground grain 57 pounds. In a general way these results agree with and confirm those of the experiment of the previous year.

An interesting feature brought out in these two experiments is shown in the amount of feed required for a pound of increase in weight at different stages in the colts' development. From April 1 to May 18, 1892, growth was made by these colts at the rate of 1 pound for each 7½ pounds of grain, while in February, 1893, the same colts, stabled in the same stalls, and under substantially the same conditions, except as to temperature, required 11 pounds of grain for each pound of increased weight. The amount of hay eaten was practically the same this year as last. * * * It is generally estimated that it costs more to winter a weanling colt than a yearling, and under average Western farm conditions this assumption is correct, but when this is the case it is probably the result of the fact that the yearling colt is capable of making better use of the rougher and cheaper feeds of the farm, and not to superior digestive and assimilative power in utilizing feed of the best quality. The weanling colt requires palatable and nutritious feed of a high quality, and is capable of rendering a good account for such a ration.

Feeding experiments with laying hens (*New York State Sta. Bul. No. 57, n. ser., June, 1893, pp. 395–407*).

Synopsis.—A comparison on four pens of pullets kept with and without a cock. The pullets in pens by themselves began laying earlier than those with the cock. As to the number of eggs laid the results were conflicting. Treatment for feather eating is described.

It is said to be widely recommended by poultrymen to keep no cock with laying hens except in the breeding pens, and the question is often asked whether hens will lay as well when kept by themselves. To test this question a trial was made with four pens of fowls, two pens (5 and 6) having a cock and two (7 and 8) without. There were 7 to 8 pullets in each pen. The comparison was between a cross of Indian Game and Buff Cochins in the one case (pens 5 and 7), and Black Minorcas and Light Brahmas in the other (pens 6 and 8).

The pullets were separated from the males when immature and some months before they began laying. Males were put with the pullets of pens 5 and 6 nearly two months before any of them began laying.

The feed was alike for all four pens, and consisted of mixed grain, wheat, fresh bone, corn silage, and alfalfa silage. Oyster shells, coal ashes, and water were kept where the fowls could get at them. The mixed grain fed consisted of two parts of corn meal, two of ground oats, one of wheat middlings, and one of old-process linseed meal, from January to June 16, when it was changed to one part each of corn meal, linseed meal, wheat middlings, wheat bran, ground oats, cotton seed meal, gluten meal, and crude gluten. "This was a very highly nitrogenous mixture and was fed as soon as warm weather began with the expectation that it might assist rapid and early molting, which it probably did, as most of the fowls had new feathers by September." An ounce of salt was added to every 20 pounds of mixed grain.

The record is given for each pen, and includes the larger part of the laying season. A summary follows:

Average weight and number of eggs from hens kept with and without cocks.

Pen.		Number of eggs laid during period.		Weight of eggs laid during period.	
		Average per fowl.	Average per laying hen.	Average per fowl.	Average per laying hen.
				Ounces.	*Ounces.*
5	Indian Game and Buff Cochins with cock....	59.96	70.26	128.18	150.15
7	Indian Game and Buff Cochins without cock..	90.04	90.04	183.63	183.63
6	Black Minorcas and Light Brahmas with cock	54.09	59.52	123.22	135.58
8	Black Minorcas and Light Brahmas without cock...	53.77	53.77	124.84	124.87

The pullets in pen 7 laid about 22 per cent more eggs than those in pen 5 (34 per cent more *per fowl*, cockerel in pen 5 counted) and although the consumption of food was somewhat greater per fowl for pen 7 the cost of eggs produced was nearly 30 per cent less than for pen 5. During the first three months for which records are given pen 8 also produced 32 per cent more eggs per fowl than pen 6. After this the yield fell below that for pen 6 owing, doubtless, to the confirmed habit of feather-eating which had been purposely allowed to develop unchecked in pen 8. The total yield for the eight months, however, was about the same, calculated to the average per fowl, for pens 6 and 8, slightly in favor of pen 8. The consumption of food was enough greater in pen 8 to make the cost of eggs produced slightly exceed that for pen 6. * * *

In each of the two pens without male birds some pullets had begun to lay from one to two months earlier than any in the corresponding pens in which male birds were kept.

The habit of feather-eating developed in pen 8, and after a few weeks every fowl in the pen had acquired it or was suffering from it. It is believed to have been due to "idleness, to some extent consequent upon the necessary confinement of the fowls." Vaseline or lard mixed with powdered aloes was rubbed on the old feathers near the spots that had been picked bare and on the new feathers which appeared. "After continuing this treatment for some time the habit apparently disap-

peared so that the birds were enabled to grow a full coat of new feathers. No change of any consequence was made in the food, etc., and the suppression of the habit was probably due to the disagreeable taste of the aloes. The means taken to discourage this habit necessitated frequent handling of the fowls and would not pay with ordinary stock. It would be more economical to kill the birds first affected."

The habit is said to be more commonly due to improper feeding, or lack of animal food or of variety in the ration. Cases are mentioned in which the habit was, apparently, brought on by feeding corn or corn meal exclusively. "As the spread is rapid even under a ration which does not ordinarily seem to encourage its development the vice should be stamped out by the death or removal of the first offender."

Live stock and poultry, D. N. BARROW (*Louisiana Stas. Bul. No. 22, 2d ser., pp. 673–675*).—Notes on the Holstein and Jersey cattle of the State station herd are given. The record of thirteen breeds of poultry for a period of 100 days shows that the Silver Spangled Hamburgs were the best layers, averaging 0.64 of an egg per day and hen, followed by the Brown Leghorns with 0.48 of an egg per day and hen. The eggs of the latter were larger than those of the Silver Spangled Hamburgs.

VETERINARY SCIENCE AND PRACTICE.

J. F. DUGGAR, *Editor*.

Report of veterinarian, W. H. DALRYMPLE (*Louisiana Stas. Bul. No. 22, 2d ser., pp. 721–730*).—The following diseases of horses and mules occurred in Louisiana in 1892: Acute nephritis, paraplegia, eczema, glanders, and cerebritis or blind staggers. An attack of acute nephritis which occurred on one plantation was attributed to the use of badly molded pea-vine hay and of water from a shallow well, surcharged with organic matter. On another plantation the mules suffered from weakness in the back just over the kidneys and from a trembling of the hind legs and quarters. Ten or twelve mules were lost by this disease, which was pronounced paraplegia. It was attributed to excessive pressure on the loins, caused by the back bands being placed almost as far back as the point of the hips. In one parish cerebritis was prevalent. It was attributed to the use of moldy corn, caused by wet weather while the corn was in the milk stage. In the moldy corn, used as food for the horses which succumbed to cerebritis, the mold *Aspergillus glaucus* was identified, and in some samples *Mucor mucedo* was present. These molds will be used for innoculating small animals.

Scab, lumpy jaw, and anthrax, D. A. CORMACK (*South Dakota Sta. Bul. No. 36, June, 1893, pp. 95–105*).—This bulletin was issued, not as original matter, but to advise stockmen concerning scab, lumpy law, and anthrax.

For the treatment of scab of sheep, various sheep dips are recommended, and it is further advised that sheds, yards, and fences should be thoroughly cleaned and disinfected with a solution of boiling lye, or carbolic acid, followed by a coat of whitewash.

The bulletin contains a short discussion as to the nature and occurrence of lumpy jaw (Actinomycosis), and an extract from the report of the Bureau of Animal Industry of the United States Department of Agriculture, giving directions for the iodide of potassium treatment.

The symptoms of anthrax and the disposal of animals which have succumbed to this disease are briefly treated. If the animals are buried, it is advised that the ground over the carcasses be fenced in for at least one or two years so as to prevent cattle pasturing on it.

Dehorning cattle (*Georgia Sta. Bul. No. 21, Aug., 1893, pp. 42–46, fig. 1*).—Eight milch cows were dehorned. A record kept for one week previous to the operation and for one following it, is tabulated. In five out of the eight cases there was slightly less milk given the week following the dehorning than the week preceding it. The results following the dehorning were altogether satisfactory. The disposition of one cow, which had been quarrelsome and unruly, was entirely changed. "Immediately after dehorning she became, and has continued since, one of the most kind and docile of the herd."

Directions are given for performing the operation and an illustrated description of a stanchion for use in dehorning cattle.

Dehorning, I. P. ROBERTS (*New York Cornell Sta. Bul. No. 54, June, 1893, pp. 111–124*).—*The legality of dehorning.*—The legal aspect of dehorning in the United States, Canada, and Great Britain is discussed.

In the United States, so far as we have been able to learn, all trials upon charges of cruelty to animals by dehorning have resulted in the acquittal of the accused parties.

In Canada at least two trials resulted in the acquittal of the accused, but in a third trial the conviction of the parties resulted in the appointment of a Government commission which made a report strongly recommending the practice and urging the passage of the necessary legislation to give it effect.

In Great Britain there have been decisions on both sides, those in Ireland and Scotland being in favor of the legality of the practice and those in England, notably that of Lord Chief Justice Coleridge and Mr. Justice Hawkins, against. Of twenty judges of higher courts who have passed upon the subject, sixteen declared the practice to be legal, while four pronounced it illegal.

Means of preventing the growth of horns.—Five calves, ranging from 30 to 64 days old, were used in the experiment. The following chemicals were applied to one or more horns: Caustic potash, hydrochloric acid, sulphuric acid mixed with sulphur, sulphuric acid with glue and carbolic acid, chloride of zinc, chromic acid ointment, and chromic acid solution. One week after the application an examination showed that only the caustic potash and the mixture of sulphuric acid and sulphur had destroyed the horn. The following chemicals were then applied to one or more of the unaffected horns: Chloride of mercury and hydro-

chloric acid, chloride of mercury and sulphuric acid, and caustic potash. The caustic potash was less concentrated than that previously used, and destroyed only one of the two horns to which it was applied. The other treatments were ineffectual.

On seven other calves, aged one month or less, the growth of horns was prevented by a single application of caustic potash.

The use of caustic potash is by far the easiest, most humane, and most certain method of securing hornless cattle. * * *

The manner of applying caustic potash is as follows:

The hair should be closely clipped from the skin and the little horn moistened with water to which soap or a few drops of ammonia have been added to dissolve the oily secretion of the skin, so that the potash will more readily adhere to the surface of the horn. Care must be taken not to moisten the skin except on the horn where the potash is to be applied. One end of a stick of caustic potash is dipped in water, until it is slightly softened. It is then rubbed on the moistened surface of the little horn. This operation is repeated from five to eight times, until the surface of the horn becomes slightly sensitive. The whole operation need take only a few minutes, and the calf is apparently insensible to it. A slight scab forms over the surface of the budding horn and drops off in the course of a month or six weeks, leaving a perfectly smooth poll. No inflammation or suppuration has taken place in any of the trials we have made.

Patented chemical dehorner.—The John March Company's Chemical Dehorner, covered by a patent issued July 12, 1892, was analyzed and found to consist of a solution of 32.25 per cent of caustic soda in water. The following conclusions were reached:

(1) The John March Company's Chemical Dehorner is undoubtedly effective for the purpose intended. (2) It is sold at an exorbitant price. (3) There need be little fear of infringement of a patented article consisting of a single well-known chemical reagent, or of a method already so well known and advertised.

ENTOMOLOGY.

Report of the entomologist of the Louisiana Station, H. A. MORGAN (*Louisiana Stas. Bul. No. 22, pp. 731–736, 2d ser., fig. 1*).—The corn root worm (*Diabrotica 12-punctata*) greatly damaged the stands of corn and melons in March and April. The presence of the larva may be detected by the wilted appearance of plants a few inches high. Eggs were found upon germinating melon seed. Corn plants protected from insects until 6 inches high and melons protected until they began to run were not attacked on exposure in infested fields.

Corn was soaked in kerosene emulsion, pure and diluted, copper sulphate solution (one-half ounce copper sulphate per gallon of water), and a solution of 1 ounce of kainit in 1 quart of water. The best results were from the use of kerosene emulsion, the corn soaked in the ordinary and in the undiluted emulsions giving perfect stands.

For the horn fly (*Hæmatobia serrata*) cattle were sprayed with a 5 per cent solution of eucalyptus oil, with a 1 per cent solution of Chryst-Jeyes fluid, with kerosene emulsion, and with emulsions of black

machine oil, fish oil, and sludgite. Only kerosene and fish-oil emulsions were of much value, and of these the latter was the more effective. A weak emulsion of fish oil, made as follows, gave good results:

Dissolve one half pound of common hard soap in 1 gallon of boiling water, add 2 gallons of fish oil, churn the solution for several minutes, and then dilute with 15 to 20 parts of water to 1 part of the solution.

The southern grass worm (*Laphrygma frugiperda*) was destructive to corn and pea vines on overflowed lands. A large black grub (*Calosoma calidum*) was found eating the caterpillars.

In eggs of the Harlequin cabbage bug there was found at Homer, Louisiana, a parasite, *Trissolcus morgantiæ*.

The codling moth and hop louse, F. L. WASHBURN (*Oregon Sta. Bul. No. 25, Apr., 1893, pp. 1–13, figs. 4*).—A report upon the results obtained during 1892 on the investigation of these insects. The work is a continuation of that reported in Bulletin No. 10 of the station (E. S. R., vol. II, p. 660). Four or five broods of the codling moth may be expected each season. The author thinks three, or at most four, sprayings sufficient.

For the hop louse, spraying with kerosene emulsion, quassia and soap, and tobacco and soap is recommended. A wire trellis for hops is described and figured.

Common insect pests, T. A. WILLIAMS (*South Dakota Sta. Bul. No. 35, May, 1893, pp. 83–87*).—Descriptions, life histories, and methods of destruction are briefly given for the following insects: Codling moth (*Carpocapsa pomonella*), gooseberry and currant spanworm (*Eufitchia ribearia*), cabbage worms (*Pieris rapæ, P. protodice*, and *Plusia brassicæ*), potato beetles (*Doryphora 10-lineata* and *Epicauta* spp.), plant lice (*Aphididæ*), cottonwood and willow leaf beetles (*Lina scripta* and *L. lapponica*), large willow sawfly (*Cimbex americana*), ash sawfly (*Monophadnus bardus*), ash tree sphinx (*Darem maundulosa*), emperor moth (*Attacus cecropia*), and American silkworm moth (*Telea polyphemus*).

Analyses of insecticides (*Massachusetts State Sta. Report for 1892, p. 336*).—Compiled analyses of Paris green, Sulphatine, Death to Rose Bugs, DeGraff's Carpet Bug Destroyer, tobacco liquor, Nicotinia, hellebore, and Peroxide of Silicates.

Preparation and application of insecticides, L. C. CORBETT (*South Dakota Sta. Bul. No. 35, pp. 88–92*).—Formulas and directions for use are given for the following insecticides: Kerosene emulsion, kerosene and milk emulsion, lye wash, pyrethrum, quassia, soap and tobacco, tobacco dust, tobacco tea, Paris green, London purple, and hellebore. The following fungicides are also given: Ammoniacal carbonate of copper, Bordeaux mixture, modified eau celeste, corrosive sublimate solution, and directions for combining insecticides and fungicides.

DAIRYING.

E. W. ALLEN, *Editor.*

Practical dairying, R. J. REDDING (*Georgia Sta. Bul. No. 21, Aug., 1893, pp. 29–42, fig. 1*).—This is a popular article on the selection and treatment of the dairy herd, the use of Wolf's tables in compounding rations, with abstracts from a paper on the feeding and management of cattle, by W. A. Henry; and remarks on testing milk and the Babcock milk test, together with results of tests made by this method of the milk of the cows of the station herd, and on the De Laval cream separator.

It will be found absolutely impracticable, with the average well water of Georgia to maintain a lower temperature of the milk than from 62° to 65° F. Recourse must be had either to the separator or to the use of ice. If more than five or six good cows are milked it will pay to get a separator; if less, resort must be had to ice, in order to get the best results. The ordinary method of setting milk, without even the use of cold water which prevails almost universally, in domestic dairying in the South, is exceedingly wasteful, especially in the summer, resulting in a loss of fully one-third of the butter contained in the milk, as compared with the use of a separator, or setting in ice water.

A contribution to the study of the economies of milk production, C. F. VANDERFORD (*Tennessee Sta. Report for 1892, pp. 77–86*).—A reprint of Bulletin vol. V, No. 3 of the station (E. S. R., vol. IV, p. 419).

Analyses of milk of different breeds of cows, C. A. GOESSMANN (*Massachusetts State Sta. Report for 1892, pp. 57–61*).—This is a tabulation of the results of analyses made with the Babcock milk test of the milk produced by private herds on a number of farms within the State, accompanied by a statement of the method of feeding. The breeds represented are Guernsey and Holstein.

Analyses of dairy products (*Massachusetts State Sta. Report for 1892, pp. 293–295, 334*).—Analyses of milk in 1892, and a compilation of analyses of whole milk, skim milk, buttermilk, cream, butter, and cheese.

Sweet vs. ripened cream butter, G. E. PATRICK, F. A. LEIGHTON, and W. H. HEILEMAN (*Iowa Sta. Bul. No. 21, pp. 788–791*).

Synopsis.—Three comparative experiments of making butter from sweet cream and cream ripened from seventeen to twenty-one hours. When kept for about six months at a temperature of about 50° F., the sweet cream butter suffered less deterioration than the ripened cream butter, and in some measure acquired the flavor characteristic of the latter.

Three experiments are described in making butter from sweet cream and from the same cream ripened from seventeen to twenty-one hours at about 60° F. The amount of cream used was 425, 228, and 320 pounds, respectively. In one trial, the time required for churning was practically the same for both kinds of cream. In the two others, how-

ever, considerably more time was required for churning the sweet cream. In the first trial, the loss of fat in the buttermilk was 8.02 pounds for the sweet cream and 1.14 pounds for the sour cream. "Why the sweet cream churned so poorly in the first trial, we do not know, but probably a longer churning would have reduced the loss." In the second trial, the loss of fat in the buttermilk was 0.34 pound for the sweet cream and 0.97 for the ripened cream; and in the third trial, 0.77 pound for the sweet cream and 0.65 for the ripened cream. In the second trial, therefore, the loss was less in churning the sweet cream.

"In neither trial was the churning what may be considered close; that it was not closer with the ripened cream is perhaps because the ripening was allowed to proceed only to a very moderate extent in each case."

To observe its keeping qualities, a 10-pound tub of each lot of butter from each trial was placed in storage at a temperature of about 50° F. immediately after making. The butter was made September 30, October 10, and October 26, respectively. Samples were examined January 30, and again April 22.

"These results on the comparative keeping qualities of sweet and ripened cream butter agree perfectly with those obtained in our former experiments, reported in Bulletin No. 18 (E. S. R. vol. IV, p. 425).

"The sweet-cream butter suffered less deterioration from keeping than did the ripened cream product, and in some measure acquired the flavor characteristic of the latter."

Some bacteriological work in the dairy, L. H. PAMMEL (*Iowa Sta. Bul. No. 21, pp. 797–804, figs. 6*).—These studies consist of observations on the effect of peroxide of hydrogen and of salicylic acid on the ripening of cheese; determination of the number of bacteria in rennet, cheese curd, whey, buttermilk, and butter; and a description of three bacilli found in ripening cheese. In rennet all the way from 409,500 to 4,019,200 germs per cubic centimeter were found.

One interesting feature about the micro-organisms in rennet is that they required more than twice the usual time for the colonies to develop. From milk, butter, and cheese the colonies were usually well developed in three days, but in rennet in from 48 to 120 hours, usually the latter. Rennet, no doubt, acts in retarding development, and I am inclined to think that the bacteria in rennet are not so important in ripening cheese as the bacteria found in milk, but this should be confirmed by experiment. As to the kinds occurring, the anaërobic, those growing in the absence of oxygen, predominated. The aërobes were comparatively few, and these developed much faster. The anaërobe most common was a *Micrococcus* occurring in chains, producing whitish lens-shaped colonies. An aërobic yeast, *Saccharomyces*, was also present. These may be described at some future time.

An aromatic bacillus of cheese, L. H. PAMMEL (*Iowa Sta. Bul. No. 21, pp. 792–796*).—The author describes an aromatic bacillus (*Bacillus aromaticus*) which was originally found on cabbage affected with a rot. In bouillon cultures the bacillus gave an odor similar to that of Limburger cheese. In milk it grew readily at the ordinary temperature of

the room and produced the odor noticed in the bouillon cultures. The milk curdled in about forty-eight hours, but it does not appear certain that the bacillus caused the curdling. In several trials milk was inoculated with the bacillus and cheese made from it. After curing for several months the cheese "had a flavor of its own somewhat sharper and stronger than ordinary cheese, and to some perhaps not desirable, but it suited my taste. Others who tested the cheese also praised it in the highest terms. * * * Our cheese began to swell, owing to the presence of gas; a section through the cheese showed numerous holes from the imprisoned gas."

Creamery record for 1891 and 1892, C. A. GOESSMANN (*Massachusetts State Sta. Report for 1892, pp. 46–56*).—This record includes a statement of the local market price per ton of the various feeding stuffs used; analyses of the same with reference to fertilizing ingredients; a record of the amount of each kind of food consumed and the milk produced during each month; the pecuniary result; analyses of cream; fertilizing constituents of cream; and average analyses of the milk of the station herd for each year since 1884.

Making allowance for the value of the fertilizing ingredients in the food and in the cream, the net cost of food for the production of cream averaged $21.10 per month in 1891 and $16.09 in 1892. The average amount per month received for the cream at the local creamery was $36.44 in 1891 and $33.48 in 1892. The average value of the cream per quart of milk was 2.21 cents in 1891 and 2.04 cents in 1892. With whole milk at 3 cents per quart, the skim milk is calculated to have cost, on an average, 0.95 cents per quart in 1891 and 1.12 cents in 1892.

The total cost of feed for 1 quart of cream amounted in 1891 to 13.93 cents, and in 1892 to 13.35 cents. * * *

The net cost of feed per quart of cream averaged in 1891 7.37 cents and in 1892 5.90 cents. Received per quart of cream in 1891 12.73 cents and in 1892 12.27 cents, thereby securing a profit of 5.36 cents per quart in 1891 and 6.37 cents in 1892.

Investigations in cheese-making, H. C. WALLACE (*Iowa Sta. Bul. No. 21, pp. 735–767*).

Synopsis.—A detailed discussion of the processes involved in cheese-making and a description of fifteen experiments in making cheese from milk containing from 1.75 to 8.4 per cent of fat. The amount of milk required to make 1 pound of cheese steadily decreased as the per cent of fat in the milk increased. The percentage of fat lost did not seem to bear any direct relation to the percentage of fat in the milk, but appeared to depend more on the care and skill exercised in making.

Prefatory to the description of the experiments, a practical discussion is given of the principles involved in cheese-making. The experiments were fifteen in number and were made with milk containing from 1.75 to 8.40 per cent of fat, the wide difference in composition being brought about by skimming or the addition of cream. The milk used was that brought to a factory by patrons living in the surrounding country. The selection of milk was made with the aid of the Babcock

milk test, and complete chemical analyses were made of the milk and the products of manufacture. The cheeses were all made in the same manner and under the same system. The process was somewhat varied at different points where milk unusually rich in fat was used, to prevent an excessive loss of fat. It was found difficult to do the best work in making cheese from milk to which a large amount of cream had been added. Such milk was usually riper because of delay in getting it started and because the cream added was usually riper than the normal milk. Each experiment is discussed in detail, and the results are summarized in a table given below.

Summary of results obtained in cheese-making.

Number of cheese.	Per cent of fat in milk.	Pounds of milk required to make 1 pound green cheese.	Pounds of cheese made from 1 pound fat in milk.	Per cent of fat in first whey.	Per cent of lost of the original amount of fat in the milk.	Per cent of casein and albumen in the milk.	Per cent lost of original amount of casein and albumen in the milk.
1	1.75	12.62	4.39	0.15	7.7	3.72	19
2	2.49	11.16	3.59	0.17	6.3	2.88	24
3	3.07	10.85	3.00	0.17	4.9	3.05	23
4	3.58	10.06	2.77	0.13	3.4	2.70	22
5	4.05	10.11	2.44	0.34	7.6	3.00	25
6	4.07	9.80	2.50	0.28	6.2	3.03	22
7	4.20	9.17	2.59	0.26	6.2	3.03	20
8	4.61	8.60	2.52	0.38	7.4	2.94	24
9	4.98	8.55	2.34	0.63	11.6	2.75	24
10	5.10	7.86	2.49	0.54	11.6	2.89	25
11	5.45	8.34	2.20	0.45	7.2	2.74	26
12	6.18	7.43	2.17	0.43	8.1	2.99	25
13	6.81	7.64	1.92	0.66	13.4	2.84	24
14	6.83	7.13	2.04	0.33	4.2	2.94	22
15	8.40	6.01	1.97	0.65	7.4	3.00	23

It will be seen that the number of pounds of milk required to make 1 pound of cheese gradually decreases as the per cent of fat in the milk increases. With three exceptions the decrease is very regular, but not proportionate to the increase in the per cent of fat in the milk. In making No. 5 more milk was required to make 1 pound of cheese than in making No. 4, although the per cent of fat in the latter case was less than in the former. There were two reasons for this—first, more fat was lost in the whey in making No. 5, and, second, more casein was lost. With No. 10 less milk was required to make 1 pound of cheese than with No. 11, although there was less fat in the milk from which the former was made, and the loss of fat was considerably greater. This is explained by the fact that No. 10 contained over 4 per cent less moisture than No. 11. With No. 13 more milk was required to make 1 pound of cheese than with No. 12, undoubtedly due to the unusual loss of fat during the process of manufacture.

Referring to the third column it will be seen that the number of pounds of cheese made from 1 pound of fat decreases as the per cent of fat in the milk increases. This was to be expected, but the figures given will not enable the cheese-maker, who handles only normal milk, to draw correct conclusions, because it is evident that the number of pounds of cheese made from 1 pound of fat depends more upon the amount of casein in the milk than upon any other one thing. In the milk from which No. 1 was made, from which half of the fat was removed, there was considerably more casein in proportion to the fat than there would be in normal milk, while there is considerably less casein in proportion to the fat in those cases where cream was added to the milk to bring it up to the required standard. Consequently the pounds of cheese made from 1 pound of fat would with normal

milk in all probability be less than the figures given for the first four cheeses and more with the others. * * * The per cent of fat in the first whey is greater in those cases where the milk contained a high per cent of fat, but it does not increase with any regularity as the per cent of fat in the milk increases. * * *

It would seem from a study of column four that the relative loss of fat in cheese-making does not depend primarily, or even secondarily, upon the per cent of fat that is contained in the milk from which the cheese is made. While the actual loss of fat increases slightly as the fat content of the milk increases, yet the per cent lost of the original amount of fat in the milk does not seem in this experiment to bear any direct relation to the per cent of fat in the milk. * * *

We think the results given indicate that the proportionate loss of fat in the manufacture of cheese depends more upon the care and skill exercised during the process of manufacture than upon the per cent of fat in the milk from which the cheese is made, and that in case it is deemed advisable to manufacture cheese from milk containing a very high per cent of fat, even though cream be added to the milk to increase it, the skillful maker will not lose a relatively greater per cent of the total amount of fat than in making cheese from milk from which a portion of the fat has been removed. There does not seem to be any foundation for the statement often made that after the fat in the milk has passed 3, 3½, or 4 per cent the excess is lost in the whey. * * * The average amount lost of the original amount of casein and albumen in the milk was about 23 per cent. It will be seen that the loss varied as much as 6 per cent, but no facts were brought out during the course of the investigation that enable us to account for this variation. This loss, as well as several other matters that have been brought to our attention during the investigation, will be studied in the future.

The cheeses are being kept and later will be judged by experts. A further report will then be made on the effect of composition of milk on the composition and relative value of the cheese.

Experiments in the manufacture of Edam and Gouda cheese (*New York State Sta. Bul. No. 56, n. ser., May 1893, pp. 361,–393, figs. 10*).—The processes of manufacture of Edam and Gouda cheese are described in detail, and the results are given of various experiments at the station in making both kinds of cheese. A practical cheese-maker, with experience in making these cheeses, was engaged for the work. The methods of manufacture so fully and clearly described in the bulletin can only be briefly outlined here.

It is remarked at the outset that the "results and methods contained in this bulletin can not take the place of actual experience. To learn the successful methods of manufacture, one must be taught by a skilled maker. The results of our work will be helpful only when used properly in connection with practical, personal experience."

The manufacture of Edam cheese (pp. 361–379).—"Edam cheese is a sweet-curd cheese, made from partially skimmed milk. It comes to the market in the form of round red balls, each weighing from 3½ to 4 pounds when cured. They are largely manufactured in northern Holland, and derive their name from a town which is famous as a market for this kind of cheese." Edam cheese is made from milk from which one-fourth to one-third of the fat has been removed. The milk is warmed to a temperature between 85° and 88° F., the coloring matter

added and thoroughly mixed with the milk at that temperature, and then the rennet.

In the trials at the station 1½ to 2 ounces of Carter's cheese color and 4½ to 5½ ounces of Hansen's rennet extract were used per 1,000 pounds of milk. The curd should be ready for cutting in from twelve to eighteen minutes after the rennet is added. After the curd has been cut into very small pieces it is rapidly heated to 93° to 96° F., stirring it meanwhile to prevent settling, and as soon as it shows signs of hardening the whey is drawn off down to the curd and the press molds filled. Specific directions are given for filling, pressing, and bandaging.

The cheese is salted by either the dry or wet process. In dry salting each cheese is placed in a salting mold with a coating of fine salt completely surrounding it for five or six days, the salt being renewed daily. In wet salting the cheese is placed for seven or eight days in a brine containing about 1 pound of salt to 2½ quarts of water.

Following the salting, the cheese is cured in a curing room having a temperature between 50° and 65° F. and a moisture between 85 and 95 per cent, as shown by a hygrometer. If the atmosphere is not sufficiently moist, Edam cheese will check and crack and be spoiled for market.

When about two months old the cheese is prepared for market by smoothing the surface in a turning lathe, coloring by placing it in a carmine solution for about a minute, coating with boiled linseed oil to prevent checking, and then wrapping in tin foil.

Following is a comparison of some points in the manufacture of Edam and American Cheddar cheese and of the relative profits from the two:

(1) One is made from partially skimmed milk; the other, when at its best, is made from whole milk.

(2) While it is very important in making Cheddar cheese to have the milk in perfect condition, it is absolutely essential in making Edam cheese.

(3) In making Cheddar cheese the removal of moisture is largely effected in the vat by the use of a higher temperature in heating the curd. In making Edam cheese the removal of moisture depends more upon the fineness of cutting the curd and subsequent pressing. The latter process is much less economical as regards loss of milk constituents.

(4) In making Cheddar cheese more or less lactic acid is formed, according to special conditions; in making Edam cheese every effort is made to hasten the process at every stage and prevent the formation of lactic acid. In one case we work to produce an acid curd; in the other, a curd as free as possible from acid.

(5) The details of salting and curing differ radically in the two methods. In general the manufacture of Edam cheese requires labor and care in giving attention to many more details than the manufacture of Cheddar cheese, however much the latter should have for best success. * * *

(6) In comparing the profit derived from the manufacture of Edam and American Cheddar cheese we must consider the character of the milk used in making Edam cheese—it is approximately one-fourth or one third skimmed milk. American Cheddar cheese made from milk of this character would hardly wholesale, on an average, for over 7 cents per pound, or, say, about 70 cents for the cheese made from 100 pounds of milk. On the other hand, Edam cheese, made from the same milk would wholesale for from 15 to 20 cents per pound, which, for 100 pounds of milk, would equal

from $1.50 to $2. After calculating the increased cost involved in making Edam cheese, it is a conservative estimate to say that the money received for 100 pounds of milk will be about double the amount received for the same milk when made into Cheddar cheese.

The results of some fourteen trials in making Edam cheese are shown and discussed. In these trials milk was used which contained from 11.20 to 12.21 per cent of total solids and from 2.45 to 3.20 per cent of fat. From 51.43 to 55.65 per cent (53.5 on an average) of the total solids of the milk was lost in the whey.

These results confirm the results of our previous study of skimmed milk in respect to loss of milk solids in cheese-making, though the losses here are greater than would ever occur in making the same milk into Cheddar cheese. * * *

In the cheese made from 100 pounds of milk there were retained from 4.50 to 6.17 pounds of water, with an average of 5.16 pounds. This is a very much larger amount of water than is retained in cheese made from normal milk by the ordinary Cheddar process. Edam cheese loses about 8 per cent of its weight in curing.

The manufacture of Gouda cheese (pp. 380–386).—"Gouda cheese is a sweet-curd cheese made from whole milk. In shape the Gouda cheese is somewhat like a Cheddar with the sharp edges rounded off and sloping toward the outer circumference at the middle from the end faces. They usually weigh 10 or 12 pounds, though they vary in weight from 8 to 16 pounds. They are largely manufactured in southern Holland, and derive their name from the town of the same name. The cheeses made in these experiments had their largest diameter about 10 inches, and were about 4 inches high when green."

Fresh sweet milk is heated to 88° to 90° F., 1 ounce of Hansen's cheese color per 1,200 pounds of milk mixed with it, and then 4½ to 5 ounces of Carter's fresh rennet extract per 1,000 pounds of milk added. The curd should be ready for cutting in fifteen or twenty minutes. It is cut the same as in the Cheddar process, except finer pieces—the size of a pea or wheat kernel. It is heated, with constant stirring, until 104° F. is reached, which should require from thirty to forty minutes. The whey is run off and the curd placed in molds, maintaining a temperature of nearly 100° F. After being bandaged and pressed it is salted by rubbing over with salt until the salt begins to dissolve. This treatment is repeated twice daily for ten days. It is cured under conditions similar to those for Edam cheese, described above. Under these conditions the cheese ripens in two or three months.

Four trials in making Gouda cheese are reported, using milk with from 3.75 to 4.5 per cent of fat. From 7.73 to 9.66 per cent of the fat and from 22.4 to 24.45 per cent of the casein and albumen of the whole milk was lost in the whey.

From 100 pounds of milk there were made from 11.60 to 13.35 pounds of green cheese, with an average of 12.50 pounds. This was equivalent to nearly 3 pounds of green cheese for 1 pound of fat in milk. This large yield is due to retention of moisture, which varied from 4.95 to 5.79 pounds, and averaged 5.40 pounds for the cheese made from 100 pounds of milk. The amount of water in 100 pounds of cheese varied from 41.25 to 45.43 pounds and averaged 43.50 pounds. In two months the cheese had lost about 17.5 per cent of its weight in curing.

The use of the hygrometer in cheese-curing rooms (pp. 386–393).—A description of this instrument and the method of using it, and a table showing the per cent of saturation corresponding to various readings of the instrument.

"Fleischmann states that the air in a cheese-curing room or cellar (*Käsekellar*) should never go below 10° C (50° F) and never above 18° C (64.4° F). The moisture should not drop below 65 per cent of saturation."

TECHNOLOGY.

Shrinkage of wool, C. F. CURTISS (*Iowa Sta. Bul. No. 21, pp. 775–777*).

Synopsis.—A comparison of keeping wool for about a year in three different ways, namely, in a tightly closed box, in a sack suspended from the ceiling, and wrapped in paper. No difference in shrinkage was apparent.

To observe the loss occasioned by handling and keeping wool under varying conditions, 24 fleeces were divided into four lots and kept by three different methods for about a year. Three lots of the wool were from high-grade Shropshire sheep, clipped between April 14 and 18, 1892. The fourth lot was sheared June 15 from a flock of mixed Shropshire and Southdown sheep. One lot was packed in a tight box with a close-fitting cover, another was placed in a sack suspended from the ceiling, and a third was placed upon a shelf and tightly covered with paper to keep out the dust. The lot sheared June 24 was placed in a sack and suspended from the ceiling. All four lots were kept in the same room. The results of weights taken at different intervals during the year are tabulated.

There was practically no change of weight in the first three lots of wool sheared in April. In fact, the aggregate weight of the three lots on June 15, 1893, was exactly what it was when taken off in April, 1892. Some variation occurred in the meantime, a few of the changes being hard to account for, but the variation was not great at any time.

The late-clipped wool, however, showed a loss during the year of about 6 per cent of the original weight, and as the first weight was not taken until a week after shearing, there may have been an additional loss that was not determined.

Preservative and remedial processes applied to wines of warm countries, L. PAPARELLI (*California Sta. Report of the Viticultural Work during the seasons 1887–'89, pp. 275–342, figs. 2*).—Under this head are discussed at length the sterilization of wines by filtration through "Chamberland candles," the application of electricity in the aging and conservation of wines, the use of ozone for the same purposes, and the pasteurization of wine. The effect of pasteurization is thus summarized:

(1) All fermentative germs, of whatever nature, are killed by the heat; the more promptly the higher the heat and the alcoholic contents of the wine. Wines poor in

alcohol, and especially those containing a remnant of sugar, require a higher temperature than those fully fermented out and rich in alcohol.

(2) Acids present in the wine are, under the influence of the heating, partly neutralized by entering into combinations (ethers) which form part of the flavors of older wines, hence acetified wines become of milder taste at once, and even milk-sour ones gradually lose their "scratchiness," if not too far gone.

(3) Wines while maturing in the cask are always found more or less impregnated with atmospheric air (oxygen), the gradual absorption of which forms a most essential part of the maturing process. After pasteurizing the wine is found free from oxygen, proving that it has been absorbed during the process, thus often accomplishing, in a short space of time, an advance toward maturity that at the ordinary temperatures would have required several months.

(4) When the heat is raised sufficiently high (to about 160°, which can be done without injury to common wines) the unstable "albuminoid" substances of new wines, that continue to cause the formation of deposits of lees for one or even two years after the completion of the vinous fermentation, are at once rendered insoluble, and thereafter cease to give trouble; the wine, after having been cleared by settling or filtration, forms no more deposits, and can if necessary, be bottled.

"Chamberland candles" and Houdart's apparatus for pasteurizing wines are described in detail.

In the Appendix (pp. 343–345) Carpené's new method of analysis of the raw materials containing tartrates and a short discussion of the methods of ascertaining the strength of wines are given.

AGRICULTURAL ENGINEERING.

Drainage, J. M. BLOSS (*Oregon Sta. Bul. No. 26, May, 1893, pp. 11, figs. 2*).—An address on the principles and practice of drainage as applied to Oregon, delivered before the Marion County Horticultural Society, Salem, Oregon.

Tile drainage, D. N. BARROW (*Louisiana Stas. Bul. No. 22, 2d ser., p. 675*).—Tile drains 3, 3½, and 4 feet deep all gave as good results when laid 40 feet apart as when closer. The tile-drained soil was less inclined to crust and puddle than formerly.

Early vs. late irrigation, J. W. SANBORN (*Utah Sta. Bul. No. 23, July, 1893, pp. 11–14*).—To ascertain "the proper time to begin and to close irrigation," experiments were made during 1890, 1891, and 1892 on three sets of plats of poor, dry, upland soil. "In the first series irrigation began on the plats in one set earlier than on the other, but all ended the same day. In the second set irrigation closed at a later period in plant growth on one set than on the other, and in the third set irrigation began earlier and ended later with one plat of the series than for the other." Potatoes and wheat were the crops experimented on the first year and wheat and oats the second and third years.

By the system of both early and late watering decidedly larger crops of grain were received, and only a little less of straw. While the crops were light and for only a plat by each method for this trial, yet the result is the average for three years,

and accompanied by a rotation of the plats, so that each plat was treated by each method. If the figures represent a law it would appear that grain can be watered at a later period than is customary. The watering in each case for the late watering was but a short time before harvesting, being from five to ten days after the last watering of the late-watered plats.

The following is the author's summary of results:

(1) Very early watering was not an economical process.

(2) Very early watering increased the yield of grain and the ratio of grain to straw, but not the total yield of grain and straw.

(3) Very late watering increased the total yield.

(4) Very late watering increased the ratio of grain to straw.

(5) Irrigation changes the ratio of straw to grain.

STATION STATISTICS.

Reports of treasurer and director of Maine Station for 1892 (*Maine Sta. Report for 1892, pp.* III–VIII).—General statements regarding the work of the station, a financial report for the fiscal year ending June 30, 1892, and a table of contents and index.

The work of the station during 1892 has been in the following lines:

(1) Inspection of fertilizers; (2) analyses of cattle foods, including certain patent foods which are offered for sale at greatly advanced prices; * * * (3) investigations concerning the secondary effects of pollination; * * * (4) experimental work on varieties and methods of treatment of certain garden vegetables, including cabbages, tomatoes, and egg plants; (5) contents, cultivation, and care of small and large fruits which are being tested; (6) spraying experiments, specially with reference to the apple scab and codling moth; (7) the identification and description to inquirers of such injurious plants and insects as are sent to the station; (8) investigations in plant nutrition bearing upon the economical use of crude fertilizing materials; (9) digestion experiments; (10) feeding experiments with swine and milch cows.

Sixth Annual Report of Nebraska Station (*Nebraska Sta. Report for 1892, pp. 27*).—Brief general statements regarding the work of the station by the director, botanist, chemist, entomologist, geologist, horticulturist, and physicist, together with a detailed financial report for the fiscal year ending June 30, 1892. The principal lines of work followed in 1892 were on sugar beets and animal diseases.

Report of director of North Dakota Station for 1892, H. E. STOCKBRIDGE (*North Dakota Sta. Report for 1892, pp. 31, plates 6*).—This includes general statements regarding the work of the year, summaries of Bulletins Nos. 5–8, and a financial statement for the fiscal year ending June 30, 1892. The chemical department of the station is studying the soils of the State. The horticultural department reports experiments with Russian willows and poplars, evergreens, orchard fruits, grapes, vegetables, and grasses. In the botanical department attention was given to the following subjects: "(1) Treatment for prevention of potato scab; (2) hastening maturity of potatoes; (3) propa-

gation of cereals from immature seed; (4) testing of seed wheats and compilation of results; (5) root tubercles of the legumes of the State; (6) the native flora; (7) fluids for preservation of plants, fruits, etc., in natural condition." The agricultural department is conducting field experiments with wheat, oats, peas, forage plants, and root crops.

Fifth Annual Report of South Carolina Station (*South Carolina Sta. Report for 1892, pp. 28*).—General statements regarding the work of the station and a financial report for the fiscal year ending June 30, 1892. Field experiments are being conducted with corn, cotton, forage plants, potatoes, sorghum, and tobacco. In horticulture the work includes orchard and small fruits, grapes, cantaloupes, beets, watermelons, cucumbers, tomatoes, cabbages, onions, beans, turnips, and nuts. Analyses are reported of millo maize, Kaffir corn, Jerusalem corn, pearl millet, sorghum, sugar beets, teosinte; silage from millo maize, corn, and sorghum; fertilizers; waters; ores and minerals; clay, and marls.

Third Annual Report of Tennessee Station (*Tennessee Sta. Report for 1890, p. 15*).—Brief general statements regarding the work in several departments of the station; a list of bulletins published during the year, and the treasurer's report for the fiscal year ending June 30, 1890.

Fourth Annual Report of Tennessee Station (*Tennessee Sta. Report for 1891, pp. 12*).—Brief general statements regarding the work in the several departments of the station; a list of bulletins published during the year; and the treasurer's report for the fiscal year ending June 30, 1891.

Fifth Annual Report of Tennessee Station (*Tennessee Sta. Report for 1892, pp. 96, figs. 23, plates 8*).—This includes general statements regarding the work in the several departments of the station; the treasurer's report for the fiscal year ending June 30, 1892; a summary of Bulletins vol. V, Nos. 1, 2, and 4; an account of feeding experiments with milch cows; the history and organization of the station; and the text of laws relating to the station.

Second Annual Report of Washington Station (*Washington Sta. Report for 1892, pp. 8–14*).—Brief general statements regarding the work of the station, and a financial report for the fiscal year ending June 30, 1892. The work has included field experiments with wheat, oats, barley, corn, grasses, potatoes, flax, and sugar beets; experiments with poultry, and the testing of varieties of orchard and small fruits, and forest trees.

ABSTRACTS OF PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE.

Nostrums for increasing the yield of butter, H. W. WILEY, (*Division of Chemistry, Farmers' Bulletin No. 12, pp. 16*).—The object of this bulletin is to expose such frauds as "black pepsin," "gilt-edge butter compound," and similar materials which have been quite extensively advertised for increasing the yield of butter. It is claimed in the advertisements that from a pound of butter, a quart of milk, and a small quantity of the butter compound, 2 pounds of butter may be made. The bulletin shows that these compounds consist essentially of salt, coloring matter, and a little pepsin or rennet. When the mixture of butter, milk, and a little of the compound is churned the pepsin or rennet causes the milk to coagulate and solidify with the butter. Butter made in this way contains an excessive amount of water, as directions are given not to work the butter, and also contains the casein, milk sugar, and other ingredients of the milk. Hence such butter can be kept only for a short time without spoiling. The butter compounds are retailed at from $2 to $2.50 a box of about 2 ounces. Their sale and use is regarded as fraudulent, and farmers are cautioned against buying them. They are assured that "any substance which is presented to them for the purpose of increasing the yield of butter above that of the normal belongs to some such class of fraud as has been exposed in this bulletin." Butter made with the aid of these compounds can be distinguished from genuine butter by melting a sample in an ordinary test tube and comparing it with a similar sample of melted genuine butter. "In the adulterated article almost half of the whole volume will be a mixture of water, curd, and other materials, while with the genuine article of butter the fat will separate in a clear, limpid mass, and a small amount of water and a little curd only will appear at the top."

Monthly Weather Review (*Weather Bureau, Monthly Weather eview, vol. XXI, Nos. 1–6, Jan.–June, 1893, pp. 1–178, charts 40*).—The March number contains an original contribution on the violent storms of March 23, 1893, by H. A. Hazen; the remaining numbers are devoted exclusively to the usual meteorological topics.

Annual meteorological summary for the United States for 1892 (*Weather Bureau, Supplement to Monthly Weather Review, December, 1892, pp. 246–362, charts 7*).—A summary of weather conditions over the United States during 1892 is given in notes, tables, and charts based on data furnished by 1,669 regular and voluntary observers of the Weather Bureau.

The climate of Chicago, H. A. HAZEN (*Weather Bureau, Bul. No. 10, pp. 137, maps 3, figs. 24*).—This bulletin is a summary of meteorological observations at Chicago since 1870, and embraces discussions of the following topics: Location of Chicago, records of meteorologic observations, influence of the lake on climate, temperature of the lake water, lake water temperature at Grand Haven and Milwaukee, influence of the lake on the air temperature, prevailing winds, temperature and wind at Chicago and Indianapolis, general influence of the lake on precipitation, heaviness of precipitation with each wind, lake influence on dew-point and relative humidity, lake influence on wind velocity, mean velocity of wind during storms, land and lake breezes, pressure of the air, mean temperature, hours of observation, exposure of thermometers, mean seasonal temperature, accumulated temperature, highest and lowest temperature, cold waves, variability of temperature, diurnal range of temperature, precipitation, heavy precipitation, wind velocity, diurnal range of wind velocity, velocity of wind at different hours, storm winds, wind direction, dew-point and relative humidity, clouds, direction of wind and cloud motion, fog, smoke, cause of fog, thunder and severe local storms, diurnal variation of air pressure, first storm warning, weather predictions, storm frequency; are the seasons changing? freezing of the lake; is the water level of the lake diminishing? meteorological summary, and abstract of journal (1870–1891).

The rape plant, T. SHAW (*Office of Experiment Stations, Farmers' Bul. No. 11, pp. 20*).—A popular article on the rape plant. The following subjects are treated: Description and history of the rape plant, experience with rape in Canada, experience in growing rape in the United States, varieties, soils for rape, preparation of soils, fertilizers, methods of sowing and cultivating, and the uses of rape.

The Dwarf Essex is the only variety which has been successful on this continent. The experience of the Ontario Agricultural College, at Guelph, with this plant has been entirely favorable since its introduction on the college farm in 1889. Grown after a crop of rye, an acre of it has been found to pasture 10 to 16 head of lambs for two to two and a half months. Under more favorable conditions one acre of rape pastured 36 or 37 head of lambs for two months. Lambs have made satisfactory growth on such pasturage. Rape is especially recommended for pasturage, for soiling, and as a cleaning crop.

Foods and food adulterants—canned vegetables, K. P. MCELROY and W. D. BIGELOW (*Division of Chemistry, Bul. No. 13, part VIII, pp. 1015–1167*).—This bulletin consists of a report on analyses and

examinations of the following canned vegetables purchased in the open market: Artichokes, asparagus, beans, Brussels sprouts, corn, okra, peas, pumpkin, squash, sweet potatoes, tomatoes, macédoine, mixed corn and tomatoes, mixed okra and tomatoes, and succotash. Examinations were also made of the cans, bottles, etc., in which the vegetables were put up.

"The work with canned vegetables has been directed especially to the methods of preserving, the preservatives employed, the character of the vessels in which the goods are preserved, and to their food value and digestibility." The analyses consist of determinations of water, ether extract, fiber, ash, salt, nitrogen, albuminoids, digestible albuminoids, and carbohydrates. The preservatives looked for were boric acid, salicylic acid, benzoic acid, sulphurous acid, saccharin, and hydronapthol; and the metallic contaminations, copper, lead, tin, and zinc. The tables of analyses are prefaced by an introduction and summary by H. W. Wiley, and historical notes, methods of analysis employed, and an article on greening vegetables with salts of copper, by the authors of the bulletin. An appendix contains a variety of abstracts of articles on the occurrence of copper in canned goods, the physiological action of tin, the use of tin cans for canning, etc.

[It is explained that the true theory of canning] rests upon the fact that the germs of microörganisms capable of inducing decay of the food are killed by a high temperature. The exclusion of the external air prevents the access of new germs, and thus the foods are preserved simply because the organisms which produce putrefaction can not be introduced. A temperature high enough and sufficiently prolonged to kill these germs in vegetables tends to disintegrate many of them and render them less attractive to the eye than when in the natural state. For this reason canners have sought other methods of preserving the foods in such a way as not only to preserve them from decay, but also to preserve their natural attractiveness. * * *

Opinions are divided in regard to the wholesomeness or unwholesomeness of these added preservatives, the great weight of testimony being to the effect that while these bodies in small quantities are not injurious to health, yet the continual use of them, even in such small quantities, may finally become prejudicial. It is also shown that the same qualities which enable these preservatives to prevent the action of microörganisms, and thus preserve the food from decay, are also active in the digestive organs and hinder the normal functions of the digestive ferments. In other words, the forces which tend to preserve in this way the vegetables from decay also tend in like manner to retard the processes of digestion. * * * Concisely, the views which we have reached as a result of these investigations are these: First, that the use of added preservatives is, upon the whole, objectionable; second, that their absolute inhibition is not warranted by the facts which have come to our knowledge, but in all cases their presence should be marked upon the label of the can.

There are other added chemicals which are found in many varieties of canned vegetables, which are used not especially for the purpose of preserving them, but for adding to the attractiveness of their appearance. I refer chiefly to the use of copper and zinc salts to secure and preserve the green color of canned peas, beans, etc. The use of copper for this purpose is a very old one. Long ago it was observed that the cooking of peas, beans, and other green vegetables in imperfectly cleaned copper vessels would secure a deeper and more attractive green appearance for the cooked product. It did not take the observing cook long to discover that this

improvement in appearance was due to the copper or zinc present in the copper or brass vessels. The same effect was found to be produced when these vegetables were cooked in ordinary vessels with the use of small quantities of copper or zinc salts. Upon the whole, copper salts were found more convenient for this purpose, and hence at the present day an immense industry has grown up in the greening of canned vegetables by the use of copper and zinc, especially of the former. * * * [The data given in the bulletin show] that a large part of such canned goods exposed for sale in this country has been greened by the addition of copper, and in some cases of zinc. For instance, the amount of copper found in peas of French origin was uniformly much greater than that found in American canned peas. Of forty-three samples of American canned peas examined, 32.56 per cent were found to contain no copper, while 67.44 per cent were colored with copper. Of thirty-six samples of French peas, all were colored with copper except one, which was colored with zinc.

The amount of copper found ranged from less than 10 to over 100 mg. per kilogram. As to the effect of copper on health, it is believed that "the continued and regular consumption of even the small quantities of these materials present in canned vegetables must be regarded as at least prejudicial to health." It is deemed very desirable that vegetables artificially greened be so labeled, with a statement of the nature and amount of the greening material used.

The investigations show further that lead is a very common constituent of canned goods. This comes from using tin and solder which contain much lead. "The tin of some of the cans has been found to contain as high as 12 per cent of lead," and "analyses of numerous samples of the solder employed show it to contain fully 50 per cent of lead." In Germany the laws require that the tin shall not contain more than 1 per cent and the solder more than 10 per cent of lead.

Reports of the statistician (*Division of Statistics, Reports Nos. 105–108, n. ser., June, July, August, and September, 1893, pp. 179–369*).—Besides the crop reports, notes on foreign agriculture, and freight rates of transportation companies, these reports contain articles on the following subjects: Report No. 105—Agriculture in the Caucasus, The customs tariff of Martinique, Agricultural produce statistics of the United Kingdom; Report No. 106—Statistics of Ontario, Use of maize of the United States in Mexico; Report No. 107—The wheat crop of India for 1893, The winter oil-seed crop of India, The production of corn in New South Wales.

ABSTRACTS OF REPORTS OF FOREIGN INVESTIGATIONS.

Determination of nitrogen in nitrates and in mixtures of nitrates with organic and inorganic nitrogenous materials, V. SCHENKE (*Chem. Ztg., 17 (1893), No. 54, pp. 977–979*).—After a critical review of the numerous methods proposed for the determination of nitric nitrogen, the author selects the Ulsch method as the one most to be recommended on account of its simplicity, rapidity, and accuracy. In this method the nitric acid is reduced by gradually heating it with iron reduced in hydrogen in a solution acidulated with sulphuric acid. The author finds it very essential that the proportions between substance and reagents be correct and recommends the following: In the analysis of nitrate of soda 20 grams of substance is dissolved in 1 liter of water, and to 25 c. c. of this solution in a distilling flask are added 4 grams of iron reduced in hydrogen and 12 c. c. of sulphuric acid of 1.35 specific gravity (2 volumes H_2O and 1 volume conc. H_2SO_4). This is gradually heated to boiling, where it is maintained a few minutes, and then after washing down the inside of the flask, 50 c. c. of water and 25 c. c. of sodium hydrate solution of 1.3 specific gravity are added. The ammonia is then distilled over and collected in sulphuric acid, and the result titrated against barium hydrate. It is advisable to use a safety tube in the distillation to prevent any of the alkali being carried over. The reduction requires eight to ten minutes and the distillation about twenty minutes. A large number of determinations can be carried on simultaneously. By using 6 grams of iron and 20 c. c. of acid mixture, 1 gram of nitrate of soda may be thoroughly reduced.

The following combination of the Ulsch and Kjeldahl methods is recommended for the analysis of mixtures containing nitrates: From 1 to several grams of the material, according to its nature, is placed in a digestion flask, mixed with water to a pasty consistency, from 1 to 4 grams of iron added, according to the amount of nitrogen, and from 5 to 10 c. c. of sulphuric acid of the strength given above. In the case of substances rich in lime relatively more sulphuric acid is added. The mixture is then digested carefully until the end of the reaction. A little copper oxide and about 15 c. c. of sulphuric acid containing 200 grams of phosphoric anhydride per liter of concentrated acid are then added and the mixture is again digested as in the Kjeldahl method until the solution becomes light green, indi-

cating the end of decomposition. The operation of digestion occupies from three-quarters of an hour to an hour and a quarter when much organic matter is present.

In distilling off the ammonia it is recommended to add a few grains of zinc to prevent bumping.

In comparisons on Peruvian guano and on a mixture of nitrate of soda, ammonium sulphate and dried blood, the above method gave very slightly higher (0.04 to 0.08 per cent), results than the Jodlbaur or Scovell-Gunning methods. The method has been satisfactorily used at the Breslau station for more than a year. The presence of chlorides, it is said, does not affect the results.—E. W. A.

The action of a ferment in ripe bananas affecting the accurate determination of sugar, F. MIERAU (*Chem. Ztg., 17 (1893), No. 55, p. 1002, and No. 56, pp. 1021, 1022*).—In studying the aqueous extract of ripe bananas the author observed that the conditions of the extraction materially affected the proportions of inverted and cane sugar in the extract. The relation of inverted sugar to cane sugar was as 10:23.4 in one case, 10:9.7 in another, and 10:5.95 in another. Subsequently he found a ferment in ripe bananas, invertase, capable of inverting cane sugar. This was destroyed by cooking the fruit previous to extracting the sugar.

His conclusions are that the sugar in ripe bananas is principally cane sugar; and that correct results are obtained only when the fruit is cooked previous to the determination of the sugar to prevent the action of the ferment. If this precaution is omitted the amount of cane sugar in the extract diminishes and the inverted sugar increases as the temperature at which the extraction is made increases. By extracting for five hours at 54°–57° C. all the cane sugar of the fruit and a considerable amount of cane sugar which was added was inverted.—E. W. A.

Bacteriological and chemical studies on egg albumen, H. SCHOLL (*Arch. Hyg., 17, pp. 535–551*).—The first part of the investigation, the bacteriological part, was made to ascertain whether the white of the egg could be made destructive to bacteria by treating it with potassium hydrate. It had been already shown that treating blood serum with potassium hydrate rendered it unfit to support bacterial life, and the author's experiment showed this to be likewise true for egg albumen. Plate cultures made of the white of fresh eggs treated with potassium hydrate produced large numbers of colonies at first, which rapidly disappeared, until after six days practically none remained.

Then followed the chemical studies, made to investigate the change which had taken place in the albumen and, if possible, to account for the effect produced on the bacteria. These studies led the author to the following conclusions:

(1) The white of normal fresh hens' eggs contains carbonic acid in combination, which is freed by the addition of an acid without the application of heat.

(2) This carbonic acid exists mainly in the form of bicarbonates, although a smaller part is in the form of monocarbonates.

(3) Heated to 60° C., a part of the carbonic acid is given off and the albumen itself very gradually coagulates.

(4) The term "coagulation temperature" does not belong in the same category with the terms boiling point, melting point, freezing point, etc., for a single definite temperature at which the coagulation will take place can not be given. The time element enters into consideration, and it is necessary in giving the temperature of coagulation to fix the time within which complete coagulation will take place.

(5) The coagulation of egg albumen bears a close relation to the decomposition of the carbonates which result in giving off carbonic acid. If the formula of egg albumen is assumed to be—

$$\left.\begin{matrix}\text{Alkali—O} \\ \text{Albumen—O}\end{matrix}\right\rangle \text{CO},$$

the union of two molecules to form coagulated albumen with the formula

$$\left.\begin{matrix}\text{Albumen} \\ \text{Albumen}\end{matrix}\right\rangle \text{O},$$

would result in an alkali carbonate and free carbonic acid.

(6) Albumen treated with potassium hydrate and rendered incapable of coagulation can be changed back to normal coagulable albumen by treating it with carbonic acid.—E. W. A.

The progress in the domain of agricultural chemistry, J. König and E. Haselhoff (*Chem. Ztg., 17 (1893), No. 60, pp. 1087–1089*).—In the report of the preceding year* reference was made to experiments by Maercker which tended to show that, owing to the cumulative tendency of phosphoric acid in the soil, the application of phosphoric acid might be decreased after the soil had become rich with applications. In other words, that the phosphoric acid not used by one crop would be retained by the soil and be available to subsequent crops. Further experiments by Maercker† have indicated that this after action of the phosphoric acid lasts only a short time, as the phosphoric acid changes to a very difficultly soluble form. He recommends, therefore, that the application of phosphoric acid be limited to the amount required by one maximum crop.

The question as to the form in which phosphoric acid should be applied to the soil has been widely studied. The extensive use of ground Thomas slag has resulted in the placing of very inferior material on the market. As compared with its efficiency, the price of the phosphoric acid in Thomas phosphate, according to the calculations of Maercker and Vogel, is relatively higher than that in superphosphates. Concerning the use of Thomas slag on meadows, Hansen‡ reports that it gave good

*Chem. Ztg., 16 (1892), p. 568.

†Ztschr. Landw. Cent. Ver. Sachsen, 1893, p. 48.

‡Jour. Landw., 40, p. 309.

results. The yield was increased when it was applied with kainit. These two fertilizers had an especially favorable effect on the growth of leguminous plants. Nitrate of soda in connection with Thomas slag increased the yield, but the profit was not as large as where Thomas slag and kainit were used.

The use of potassium phosphate as a fertilizer has been quite widely recommended. Lücke* obtained good results from its use as an intercultural manure, especially when applied with a small quantity of nitrate of soda. From other sources its use has been cautioned against as unprofitable. It is to be recommended, therefore, that further experiments be made with its use before it is generally adopted.

Immendorff,† like Holdefleiss and others, has called attention to the action of phosphoric acid in conserving the nitrogen in decaying organic matter. His investigations showed that soluble phosphoric acid retarded the fermentation and also acted as a conserving agent by fixing the ammonia produced. This action of phosphoric acid was noticeable also in the presence of air. The greatest possible exclusion of air remains, however, the best means for preserving barnyard manure.

It was mentioned in the report of the previous year that Griffith claimed to have noticed the assimilation of ammonia directly by beans, without previous nitrification having taken place. Pitsch‡ has further studied this question. By preventing the nitrification in the soil, he found that plants were able to assimilate ammonia nitrogen directly and use it for their nourishment. The plants preferred, however, the nitrate nitrogen.

Concerning the difference in efficiency of nitrate of soda and sulphate of ammonia, Wagner reported experiments in his book§ which indicated that under the most favorable conditions the efficiency of ammonium sulphate was about 90 per cent of that of nitrate of soda. He found that the action of ammonium sulphate was materially improved by the presence of carbonate of lime. This has also been noticed by Stocklasa|| in his experiments in manuring beets.

Frank's view, that not only leguminous plants but all plants have the ability to assimilate the free nitrogen of the air, has been supported by recent investigations by Liebscher. Liebscher seems to be inclined to the belief that certain non-leguminous plants are in a condition to assimilate atmospheric nitrogen when all the conditions are favorable.

Kühn¶ has argued against the practice of green manuring with leguminous plants, which has been so widely and universelly recommended since the discovery that leguminous plants can derive

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*Landw. Presse, 1891, p. 102; 1892, p. 345.

†Jour. Land., 40, p. 1.

‡Landw. Vers. Stat. 42, (1893), p. 1.

§ Die Stickstoff Düngung der Landw. Culturpflanzen.

|| Ztschr. angew. Chem., 1892, p. 595.

¶ Ztschr. Landw. Cent. Ver. Sachsen, 1893, Nos. 1, 3, and 4.

their nitrogen from the air. He declares that, with the exception of green manuring with lupines on light sandy soils, green manuring marks no progress in agricultural practice. He considers the practice of raising crops and plowing them under to be irrational and wasteful, and suggests rather that such leguminous crops be grown as can be fed to animals, and the manure thus produced used to enrich the soil in nitrogen and humus. By this method a much more thorough utilization of the crop is accomplished. In this way alone will the cost of production be diminished.

Up to the present time the chemical and mechanical means applied for the repression of nematodes have led to negative results. The root blight of the beet has been shown by Hollrung* to be caused not only by a fungus growth, but also and principally by an unfavorable chemical and physical condition of the soil. The best means of preventing the disease is believed to be frequent and deep cultivation, rendering the soil porous and allowing the air to penetrate it.

In the control of potato rot, copper preparations have been principally used. Marek † found that sprinkling the plants with copper-lime mixture gave good results. Strebl ‡ found that sprinkling or dusting over the plants with this copper-lime mixture increased not only the number of healthy potatoes but also the total amount of starch. Liebscher,§ on the other hand, cautions against the use of copper preparations, as they only give relief when applied at exactly the right time and injure the plants when their application is followed by a dry season. If the mixture is washed off from the leaves soon after application, of course neither the one result nor the other result follows.

Experiments on the effect of the quality of the seed of grains on the growth of the plant and on the quantity and quality of the yield have been reported by Kerpeley,‖ Leydhecker,¶ and Edler and Liebscher.** The former found that the growth of plants from large and fully developed wheat kernels was more uniform and vigorous and produced the largest proportion of seeds capable of germinating. Leydhecker's experiments with rye and wheat also showed the favorable influence of heavy seed on the quantity and quality of the product. Edler and Liebscher found, in agreement with Rümker, that in the case of wheat the weight of the kernel had a greater influence on the yield than the weight of the panicle. In the case of panicles of the same weight the yield of grain and straw was larger in the case of the larger kernels. The weight of the panicle had no effect on either the yield of grain or straw, but appeared to improve the quality, the average weight of the

* Chem. Ztg., 17 (1893), Repert., p. 102.

† Centbl. agr. Chem., 21, p. 469.

‡ Centbl. agr. Chem., 21, p. 691.

§ Jour. Landw., 39, p. 290.

‖ Centbl. agr. Chem., 1892, p. 545.

¶ Oesterr. landw. Wochenbl. 1892, p. 98.

** Jour. Landw., 39, p. 47.

panicle and the grain increasing as the weight of the panicle of the seed increased. In the case of oats the effect of the size of the grain was also apparent in the yield but less so in the quality of the product. The weight of the panicle of the seed had neither quantitative nor qualitative effect on the yield. Experiments by Von Liebenberg* showed the effect of the size of the seed on the yield of red clover. The smaller the seed the less favorable was the result. In another series of experiments Liebscher† found that the protein content, especially of oats, was more dependent upon the local conditions than upon the variety; and this appeared also to be true of the baking quality. There was no apparent connection between protein content and baking quality.

On the subject of animal production, Lehmann‡ has reported experiments on the digestibility of brushwood, showing that the digestibility of this material is higher the younger it is, and that the maximum of digestibility is reached when the branches are in leaf. He found that the leaves were more easily digested than the stems and branches. Salisch-Postel§ fed young brushwood to cattle, milch cows, horses, and sheep with good results. Ramm‖ found that brushwood could be fed to milch cows without unfavorably affecting the yield or quality of the milk. The value of brushwood as compared with straw was found to be as 80:100. Drying has been shown to decrease the digestibility of brewers' grains and distillery refuse in proportion to the height of the temperature used. Stutzer¶ showed that the digestibility of albuminoids of rape cake, peanut cake, and wheat bran is diminished by overheating. The same author found that in pressing brewers' grains preparatory to drying them, considerable material of value as food was lost.

In a comparison of peanut cake and sesame cake in fattening lambs, Heinrich** found a slight advantage for the sesame cake. In trials for two years, the gain, both in live weight and in dressed weight, was more favorable on the sesame cake.

Friis and Petersen†† compared the feeding value of rye bran and wheat bran with that of rye and wheat in experiments with pigs. The grains gave a much better result; the brans gave a product of inferior quality, and the loss in dressing was greater. Of the two brans wheat bran gave the better results. The result was better where only part grain was fed than where grain was fed exclusively. Beets as com-

*Centbl. agr. Chem., 21, p. 404.

†Jahrb. deut. landw. Ges., 5 (1890), p. 599; abs. in Centbl. agr. Chem. 21 (1892), p. 391.

‡Jour. Landw., 40, p. 65; E. S. R., vol. IV, p. 865.

§Centbl. agr. Chem., 21, p. 26.

‖Landw. Jahrb., 21 (1892), p. 149.

¶Landw. Vers. Stat., 40 (1892), pp. 311 and 323; E. S. R., vol. IV, p. 90.

**Landw. Ann. Meckl. pat. Ver., 1891 (E. S. R., vol. III, p. 265).

††Centbl. agr. Chem., 21, p. 306.

pared with grain for pigs gave a somewhat softer bacon, and a larger shrinkage in dressing.

In trials of feeding corn cockle, Kornauth and Arche* found this substance not to be poisonous, which is contrary to the general belief. The albuminoid metabolism was diminished and the fat production increased. Where the food consisted of 70 per cent of corn cockle the growth of the animal appeared to be diminished, although even this amount did not appear to have a poisonous action.

Maercker† has by new experiments corroborated results previously obtained by him, showing that in general rations rich in protein furnish a more valuable meat than those poor in nitrogen.

Concerning the effect of food on milk, Ramm‡ has corroborated the statement that the feeding of a larger ration of nutrients, even though this consists of the same feeding stuffs, is accompanied by an increase in the milk fat. The percentage of fat in the milk was not changed by this change in feeding. The food has also been shown to exert a material influence on the quality of the butter fat. A. Mayer§ found that different feeding stuffs were different in their effect on the content of volatile fatty acids in the butter. He arranged the feeding stuffs in the order in which they improved the consistency of the butter as follows: Coarse fodders: straw, hay, silage, old pasture grass, beet diffusion residue, and young grass; concentrated feeding stuffs: poppy cake, linseed cake, sesame cake, peanut cake, rye, cotton-seed meal, and "corn-sprout" cake. The investigations showed further that easily digestible carbohydrates—sugar-like substances—tended to diminish the melting point of the butter, and that on the contrary the feeding of substances poor in sugar, as, for instance, straw with press cakes or sour food, increased the melting point. Wood and Parsons‖ were not able to establish any relations between the melting point and the hardness of butter. According to their experiments, gluten meal gave a softer butter than corn meal, cotton-seed meal, or skim milk; and silage gave a somewhat softer butter than hay. According to Kaull,¶ the production of milk is dependent on the milking, not upon the act of milking itself, but upon the frequency, within certain limits, with which the milk cistern is emptied. Too frequent milking, as well as too seldom milking, diminishes the activity of the glands.—E. W. A.

A method for the reduction of phosphates and for the preparation of commercial fertilizers from the same, C. SEYBOLD and F. HEEDER (*Deut. landw. Presse, 20 (1893), No. 64, p. 673*).—The authors have found that the method now generally practiced of reducing crude phosphates by means of mineral acid can be replaced with advantage

* Landw. Vers. Stat. (1892), 40, p. 177; E. S. R. vol. IV, p. 90.

† Ztschr. landw. Cent. Ver. Sachsen, 1893, p. 47.

‡ Landw. Jahrb., 21 (1892), p. 810; E. S. R., vol. IV, p. 599.

§ Landw. Vers. Stat., 41, p. 14; E. S. R., vol. IV, p. 509.

‖ N. H. Bul. No. 13; E. S. R., vol. III, p. 86.

¶ Ber. landw. Inst. Halle, No. 8; E. S. R., vol. IV, p. 442.

by a simple and practical process in which carbonic acid is used as the reducing agent. The latter method is moreover applicable to phosphates rich in lime or carbonate of lime which can not be profitably converted into superphosphates by the old method.

The reduction is carried out as follows: The fine ground phosphate moistened with water is spread out in thin layers in a chamber heated to 30–120° C., through which a current of carbonic acid continuously circulates. It is also desirable to introduce steam into the chamber. The reduction proceeds according to the following formula:

$$Ca_3(PO_4)_2 + CO_2 + H_2O = CaCO_3 + 2\,CaHPO_4$$

If the reduction is carried still further superphosphate results as follows:

$$2\,CaHPO_4 + CO_2 + H_2O = CaCO_3 + CaH_4(PO_4)_2$$

In order to prepare alkali-calcium phosphates by this method it is only necessary to add to the moistened phosphate an adequate amount of carbonate of potash or soda. Supposing that carbonate of potash is used, the following reactions take place :

$$(1)\ 2\,Ca_3(PO_4)_2 + K_2CO_3 + H_2O + CO_2 = 2\,Ca_2HK(PO_4)_2 + 2CaCO_3;$$
$$(2)\ 2\,Ca_2HK(PO_4)_2 + K_2CO_3 + H_2O + CO_2 = 2CaH_2K_2(PO_4)_2$$

Other double salts can be prepared in the same way.

In order to prepare nitrogenous fertilizers, it is only necessary to first use the alkali carbonate with the addition of lime, or caustic alkalies alone, to dissolve organic nitrogenous substances such as hair, hoof, horn, leather, wool, or slaughterhouse refuse, precautions being taken to collect the ammonia evolved in acid. The fine-ground phosphate is placed in this solution and treated as already described. The caustic lime and caustic alkalies are first converted into carbonates by the carbonic acid and the reactions then go on as usual.

In the application of this method to the reduction of bone meal, the fine ground material is mixed with about half its weight of water and spread out on a flat surface in a drying oven. A fire sufficient to keep the temperature of the oven at about 60°–80° C. is maintained, and the gases of combustion are allowed to play over the moistened bone. If the material becomes dry, steam is admitted into the oven. After twelve to twenty-four hours, depending upon the kind of material used, the temperature of the oven, and the amounts of carbonic acid and steam employed, the first stage of the reduction will have been reached; a further treatment for an equal length of time will result in the production of superphosphate.

When alkali carbonates are used and double salts of potash and lime, etc., are to be prepared, the method is exactly the same, but the time is generally somewhat lessened.

The amount of alkali used may vary within wide limits. For instance, to obtain a phosphate containing chiefly $HKCa_2(PO_4)_2$ there should be added to a 20 per cent bone meal about 5 per cent of its

weight of potassium carbonate, while by adding 10 per cent of carbonate of potash, mainly superphosphate, $CaH_2K_2(PO_4)_2$, results.

The temperature may also be varied. Between 30 and 50° C. the reduction goes on slowly. At higher temperatures (80°–120° C), precipitated phosphate is first formed, and this is best transformed into superphosphate by further treatment at lower temperatures.

To obtain a nitrogenous fertilizer of about the same composition as ordinary guano, 500 pounds of organic nitrogenous refuse (such as hair, hoof, horn, leather, etc.) is dissolved in a solution of 50 parts of carbonate of potash decomposed with heat by 50 parts of caustic lime. To this solution 500–600 parts of bone meal is added and the reduction carried out as already described. By this means a fertilizer containing all three elements of plant food is obtained.

The advantages claimed for the method are that no sulphates are formed to injuriously affect plants; it furnishes a cheap available phosphate; and utilizes heretofore rejected nitrogenous substances and renders them readily available to plants.

Patents for the process have been applied for in Germany and other countries.—W. H. B.

Experiments with calcareous manures in Campine, Belgium, C. SCHREIBER (*Rev. Agron., 1893, No. 1, pp. 62–75*).—From the analyses given it appears that the sandy soils of Campine (Limbourg) contain a considerable amount of lime, but that only a small proportion of it is in combination with carbonic acid, the remainder being insoluble in hydrochloric acid and not immediately available to plants.

Experiments with calcareous manures were carried out on these soils during three consecutive years. The objects of these experiments were (1) to determine the influence of lime on germination and yield, and (2) to compare different forms of calcareous manures—lime, carbonate of lime, plaster, dolomite, and "ergeron" (a very fine quartz sand mixed with a considerable quantity of carbonate of lime and grains of glauconite or ferruginous matter).*

It was found in numerous experiments that when lime was lacking in the fertilizers applied germination was much retarded. Potatoes under these conditions were found, after three or four months, in almost the same state as at the time of planting. Oats, barley, buckwheat, peas, and lupines either failed to germinate or germinated with great difficulty. An interesting point observed was that where no fertilizer was used the germination was always more regular than where a complete fertilizer without lime was applied. This fact is not explained.

Experiments during three years on a variety of crops, including cereals and leguminous plants, clearly demonstrated the deficiency of these soils in assimilable lime. A marked increase in yield followed the application of lime in every case.

* A. Rutot and E. Van den Broeck: Quelques mots sur le quaternaire.

Lime, carbonate of lime, and plaster were each applied in amounts varying from 1 to 22 grams, to a series of vegetation pots containing 5 kg. of black heath humus, in which oats and buckwheat were grown. Lime was without effect except in case of the highest application. Carbonate of lime was more effective than the lime, but plaster produced the best results. Even with small applications it produced strong and vigorous plants.

The feeble action of the lime and of the carbonate of lime is attributed to the free humic acids contained in the heath soil. These combined readily with the lime, forming humates in which the lime is not assimilable by plants. At a temperature of 45° to 50° C. or over, carbonate of lime is decomposed by these acids and humates of lime also formed. Plaster, however, resists their action, and it is to this fact that is to be attributed its great value as a fertilizer on soils of this nature.

Since physiological analysis had shown that Campine soils are deficient in magnesia, and the observations of the author had confirmed the belief that this substance is necessary to chlorophyll formation, experiments on oats, buckwheat, and peas were carried out during 1890 and 1892 to ascertain the efficiency of dolomite (carbonate of lime and magnesia) as a source of supply of magnesia as well as lime. The experiments were made in pots containing 4½ kg. of humus soil. The amount of dolomite varied from 1 to 50 grams per pot.

From the smaller applications the effect was slight, but with 10 grams of dolomite per pot the result was marked. In the case of peat very deficient in lime and magnesia, however, very small applications gave maximum yields.

Similar experiments were made with "ergeron" on oats. This substance has the following composition:

Composition of ergeron.

	Per cent.
Lime soluble in hydrochloric acid	6.10
Lime insoluble in hydrochloric acid	3.13
Potash soluble in hydrochloric acid	0.05
Potash insoluble in hydrochloric acid	5.22
Magnesia soluble in hydrochloric acid	0.91
Magnesia insoluble in hydrochloric acid	1.59

Application of this material increased the yield considerably. This result appears to have been brought about by the joint action of the potash, lime, and magnesia which it contains. A fertilizer containing no potash except that furnished by a small quantity of ergeron gave as good results as a complete fertilizer. Apparently the lime was not effective, except where the material was applied in quantities as high as 40 grams per pot, but this was doubtless due to the formation of humates, as already explained. A fertilizer, complete, with the exception of magnesia, to which 20 grams of ergeron had been added, gave as high a yield as a complete fertilizer.—W. H. B.

Analysis of fodder corn, A. E. SHUTTLEWORTH (*Ontario College Sta. Bul. No. 89, May, 1893, pp. 4*).—In 1892 the seed of 6 promising varieties of corn was widely distributed to farmers in Ontario for testing. Reports were made from twenty counties and districts, and these reports, together with analyses of the 6 varieties of corn raised at the college, and a calculation of the yield of nutrients per acre comprise the present bulletin. The latter calculation is as follows:

Yield of food nutrients per acre by six varieties of fodder corn.

Varieties.	Protein.	Fiber.	Nitrogen-free extract.	Fat.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
Mammoth Southern Sweet (dent)	334.48	2,318.76	5,482.76	230.52
Thoroughbred White Flint	273.24	1,607.76	4,047.12	91.08
True Leaming (dent)	353.70	1,748.85	5,022.54	168.99
Mommoth Cuban (dent)	347.62	1,707.54	4,767.36	141.34
Wisconsin Earliest White Dent	316.84	1,452.48	4,311.16	135.28
Compton's Early (flint)	322.92	1,380.00	5,227.54	80.04

The 6 varieties are also grouped in the order of the potential energy of their crops. The stage at which the several crops were harvested is not stated. A consideration of the individual reports "indicates that heavier yields of fodder corn are obtained from light, warm soils than from heavy soils; they also lead to the conclusion that when the land is not specially manured for corn heavier yields are obtained after such crops as potatoes, roots, or even fodder corn, than after cereal crops, as oats, wheat, etc."—E. W. A.

Field experiments in Belgium, P. DE VUYST (*Cultures Speciales Expériences de Borsbeke-lez-Alost, 1893, pp. 40*).—The first part of this pamphlet is occupied with a discussion of experimental methods. The author considers the need of uniformity in experimental plats; the interpretation and correction of results secured on soils not entirely uniform; methods of arranging duplicate and check plats; analysis of the soil by means of plants; and methods of experimenting with varieties.

The second part is occupied with experiments made by farmers under the direction of the author in 1891 and 1892. Each of the plats was 30¾ square meters in area.

The action of a number of chemical fertilizers was tested on potatoes. Nitrate of soda in the dry season of 1892 gave a considerably larger yield than sulphate of ammonia. Nitrogen employed in large quantities considerably increased the yields, but decreased the per cent of starch in the resulting crops. Potash in the form of carbonate or kainit did not increase the yields.

A mixture of two varieties of potatoes was grown, the varieties alternating in the drill, and the same varieties were grown separately for comparison. One of the varieties grown separately yielded the maximum crop, recorded as 100. The yield of the other variety was 83 per cent of the maximum crop, or an average for the two varieties grown

singly of 91.5 per cent. The two varieties grown as a mixture yielded 98.5 per cent of the maximum crop, or a difference of 6 per cent in favor of growing them together. Attention is called, however, to the fact that such mixed samples would not satisfy the demands of the market.

In the distance experiments for potatoes all the rows were 60 cm. apart. On separate plats tubers of two varieties were planted at distances of 25, 35, 45, and 55 cm. in the drill. For one variety, 35 cm. in the drill gave the maximum yield; for the other variety, 25 cm. The author advises a distance of 30 cm., unless the object is to improve the variety and secure robust plants, in which case greater distance is recommended.

From two varieties of potatoes the tubers of greatest and of least specific gravity were planted. The heaviest tubers gave an average increase of 7.33 per cent in yield and of 1.03 per cent in starch content.

Experiments on peas indicated that nitric nitrogen was more favorable than ammoniacal nitrogen, and that its action was proportional to the amount employed. Potash was without effect. Sulphate of iron, recommended by Griffith, exercised no favorable effect. Distance experiments with peas showed that the requirements of different varieties varied widely.

With wheat the action of nitric nitrogen was equaled by that of ammoniacal nitrogen. The nitrate of soda gave best results when the whole ration was applied in the spring. Ammoniacal nitrogen was applied most advantageously one half before and one half after the winter. Phosphoric acid in all forms gave favorable results. Potash as kainit and as chloride gave no sensible increase. The yields of wheat are given only as grain and straw together, but it is said that the proportion of grain to straw varied by not more than 4 per cent on any two plats.

With oats the variation in grain and straw on the different plats was not more than 6 per cent. Only the combined yields of grain and straw are given. For oats nitric nitrogen was more favorable than ammoniacal nitrogen. Phosphoric acid in the form of slag in large amounts appears to have had a favorable influence, but potash was without effect.

With flax nitric nitrogen was more favorable than ammoniacal nitrogen. Potash was unaccompanied by any sensible increase in yield.

On meadows fertilized with mineral manures nitric and ammoniacal nitrogen were compared. The latter gave a crop 95 per cent of that with nitric nitrogen, while the yield without any nitrogen was only 78 per cent of the yield with nitric nitrogen.—J. F. D.

The manurial needs of the sugar beet, HELLRIEGEL (*Wochenschr. Cent. Ver. Rubenz. Ind., 31 (1893), No. 26, pp. 407–409*).—In three series of pot experiments conducted in 1892 single beets were grown in each pot in exhausted soil. To each of the pots in series 1 were applied 2.84 grams of phosphoric acid and 6.594 grams of potash; the nitrogen in different pots of this series was decreased from 2.94 grams to zero. Each pot of the second series received 6.594 grams of potash and 2.94

grams of nitrogen, with a supply of phosphoric acid decreasing from 2.84 grams to zero. Similarly the third series received 2.84 grams of phosphoric acid and 2.94 grams of nitrogen with a supply of potash decreasing from 6.594 grams to zero. Thus in each series two fertilizing ingredients remained constant, while the third was gradually diminished until it was dropped altogether. As a result of these experiments it was found that a decrease in the nitrogen of the manure slightly raised the sugar content of the root, reduced the weight of the root and the number of leaves, but did not affect the distribution of dry matter as between the root and leaves. As the amount of potash was decreased there was a rapid diminution of the percentage of dry matter and sugar. The plants wholly deprived of nitrogen had an average of only 21 leaves, while those deprived of potash had 58 leaves. The plants without nitrogen contained in the leaves 2.070 grams and in the root 5.618 grams of dry matter, a total of 7.688 grams in the entire plant. The plants without potash contained in the leaves 36.344 grams and in the root only 4.159 grams of dry matter, a total of 40.503 grams in the entire plant. The latter thus produced five times as much dry matter as the former, but nine-tenths of this dry matter of the plants grown without potash was absorbed by the leaves.

The author concludes that a root weighing about 800 grams requires 2.9 grams of nitrogen, 1.2 grams of phosphoric acid, and 1.7 grams of potash, or about as much nitrogen as phosphoric acid and potash together, and one-third more of potash than of phosphoric acid.

If each of the 40,000 plants on an acre were supplied with these quantities of nitrogen, phosphoric acid, and potash, the crop would require 260 pounds of nitrogen, 107 pounds of phosphoric acid, and 154 pounds of potash per acre. These are the amounts to be supplied by the soil and fertilizer together, the latter supplying only what is wanting in the former. The author holds that the best means of determining the manurial needs of a soil is by analysis of the crops grown on it.—J. F. D.

Experiments with winter wheat, T. SHAW and C. A. ZAVITZ (*Ontario College Sta. Bul. No. 90, Aug., 1893, pp. 13*).—Notes and tabulated data on 52 Canadian and American varieties of winter wheat. Of the 15 varieties grown for four years Surprise gave the highest average yield, 45.43 bushels per acre, followed by Early Red Clawson and Golden Drop. Of the 8 varieties grown for three years American Bronze headed the list with 46.99 bushels per acre, and was followed by Egyptian and Jones Winter Fife. Of the 21 varieties grown for two years the largest yields were made by Dawson Golden Chaff, 45.66 bushels. The next largest yields were made by Mediterranean and Reliable. Of the 8 varieties grown for only one year the largest yield (31 bushels) was made by the South Sea, followed by White Leader and Eureka.

In 1893 the bearded varieties weighed more per bushel than the smooth varieties; the red varieties more than the white. The bearded

and smooth varieties in 1893 gave practically the same yield per acre, but the average results for 1892 and 1893 are in favor of the bearded varieties. The Red Chaff varieties in 1893, as well as in the average of results for 1892 and 1893, yielded more than the White Chaff varieties. The red varieties, as shown by the average for the two years and by the results of 1893, gave larger yields than the white. The authors consider that these two years were not really first-class wheat years, and that this probably had an important bearing on these results.

Four varieties of wheat were sown at different dates between August 26 and September 17. The best results were from the earlier sowings.—J. F. D.

Apoplexy of the grape, F. DEBRAY (*L. Algerie agricole, 24 (1892), No. 80, pp. 121, 122; abs. in Bot. Centbl., 55 (1893), No. 1 and 2, p. 56*).—This is a disease of the vine in which the leaves suddenly wilt, the branches shrivel, and the stem is more or less affected. In Algiers it appears usually during the wet winter, and is at its height from the middle of June to the first of August. Its cause is not well known and the author has not fully investigated it. He has, however, established the anatomical changes taking place in the diseased stock. These are essentially as follows: (1) The starch is nearly absent; (2) crystals of tartrate of potassium are present; (3) the fibrovascular bundles are closed by means of "thyllen." There seems to be a close relationship between the first two, and the third affects the plant by interfering with its nutrition.—W. H. E.

Club root, W. CARRUTHERS (*Jour. Roy. Agr. Soc. England, 4, ser. 3 (1893), pp. 334–339, figs. 3; and Rep. Proc., May 31, pp. 68, 69*).—A popular description of the disease of cruciferous plants caused by *Plasmodiophora brassicæ*, and variously called anbury, club root, and finger-and-toe disease. The life history of the fungus is given. All diseased plants should be burned or composted with quick lime. The use of lime in the soil has been found very advantageous in preventing the disease.—W. H. E.

White rot of grapes, E. RATHY (*Zeitsch. Weinbau u. Kellerwirtshaft, 1892, No. 4, p. 9; abs. in Bot. Centbl., 55 (1893), No. 3 and 4, p. 118*).—The white rot is caused by the fungus *Coniothyrium diplodiella*, and its attack is confined to the fruit. It is often confounded with the black rot, from which it may be distinguished (1) by its occurring only on the fruit, never on the leaves; (2) the pycnidia are clear or brownish, not black, and the spores brown, not colorless; (3) the pycnidia are differently constructed; and (4) the spermagonia are wanting. The disease first appeared in Austria in 1891, about the same time was established in southern Austria, and has since been noticed in Hungary. The fungus is indigenous to Europe and was not imported from America, where it was first described, as it was already well known in Italy. With regard to its control, the usual copper preparations were used without avail.—W. H. E.

Insect and fungus enemies of the hop vine, C. WHITEHEAD (*Jour. Roy. Agr. Soc., England, 4, ser. 3 (1893), pp. 240–247, figs. 2*).—The hop fly or aphis (*Phorodon humuli*), whose attacks are frequently so severe upon the hop, is described and treatment suggested. Quassia and soft soap solutions are generally employed for washing the vines. The proportions are soap 4 to 8 pounds, extract from 8 to 10 pounds quassia chips, water 100 gallons. The solution is to be applied with spraying apparatus, several forms of which are described. It has been demonstrated that the female aphides migrate to the damson and other plum trees in autumn and deposit their eggs there for the next season's supply.

Wire worms often cause serious damage to the vines. They may be trapped by placing baits of potato, turnips, or rape cake around the hills. These must be examined and the wire worms picked from them twice a week.

Jumpers (*Euacanthus interruptus*) may be repressed to some extent by the use of the quassia and soap mixture or may be trapped with tarred boards.

The red spider (*Tetranychus telarius*) is very destructive during hot summers. The previously mentioned wash for the vines tends to keep them in check. When vines are badly infested they should be washed with carbolic acid and water.

The hop flea (*Halticus concinna*) often seriously attacks young vines. All old vines should be burned, and soot and lime put around the plants liable to be attacked.

Beneficial insects are described as follows: Ladybirds, ichneumon flies, lace wings, and syrphus flies.

Hop mildew or mold (*Sphærotheca castagnei*) occurs on the leaves and fruit. When upon the latter, much harm is done. A popular description of the fungus is given, and the destruction of old vines and dusting of affected ones with flowers of sulphur is advised.—W. H. E.

Feeding experiments in fattening sheep and oxen to study the effect of various rations and factors on the result at slaughtering, M. MAERCKER and A. MORGEN (*Deut. landw. Presse, 20 (1893), No. 50, p. 541; No. 52, pp. 558, 559; No. 53, p. 569, No. 54, pp. 578, 579; No. 56, pp. 595, 596; No. 58, p. 617; and No. 59, p. 625*).—These experiments were carried out under the direction of the Halle Experiment Station in coöperation with farmers of the region. In previous experiments of this nature, made under the direction of the station, the animals have not been slaughtered. In the present case, however, it was designed to study the effect of various rations and conditions on the quality of the meat and the financial result based on the quality, as well as on the total gain in live weight during the feeding. The leading thought was that in fattening animals for market the effort should be, not alone to produce the largest apparent gain in live weight, but also to produce beef and mutton of the finest quality; and the object was to determine,

if possible, a method of feeding which would result in the production of meat of the finest quality, and at the same time in good gains in weight.

The experiments were made under the auspices of the Halberstadt Agricultural Society, and extended from 1890 to 1892. A disinterested person was appointed to select the animals and have immediate supervision. In selecting the animals the herds of the several experiments were first divided into groups of 5 or 10 each. The final selection was then made, taking 2 steers from each lot of 5 and 3 sheep from each lot of 10. The selection was made to include representatives of the best, medium, and poorest animals in the herd in each case.

The slaughtering was done at a slaughter house in the vicinity, under the immediate supervision of Dr. Morgen and the secretary of the society. The weight of the organs was not taken. The data secured were the weight of the animal just previous to slaughtering and the weight immediately after dressing. The quality of the carcass was judged and the result of the feeding stated in terms of dollars and cents, with the use of a scale of fixed prices. The hide, blood, and other residue were valued alike for each kind of animal.

Incidentally, it is mentioned that in the above experiments the shearing of the sheep just previous to slaughtering rendered it difficult to judge correctly of the carcass, as the appearance of the skin was almost invariably more or less injured by shearing. It is recommended that in such experiments the sheep be sheared at least a week before slaughtering, or not all.

In the several series of experiments reported, the rations were in some cases lower than Wolff's standards, and in other cases higher in all nutrients or in respect to a single nutrient. The details as to the kinds of feeding stuffs used and the duration of the trials are usually not given.

Effect of increasing or diminishing the nitrogen-free nutrients on the increase in live weight and on the quality of the product.—(1) Trial with a deficient amount of nitrogen-free nutrients.—This trial was made on a single farm with two lots of oxen, one lot receiving the amounts of nitrogen-free nutrients (nitrogen-free extract and fat $\times$ 2.5) called for by Wolff's standard, and the other a smaller amount. The results follow:

Comparison of full and deficient rations of nitrogen-free nutrients.

	Nutrients fed per 1,000 kg. of initial live weight.		Live weight per animal at beginning.	Average daily increase per 1,000 kg.	Per cent of live weight retained in dressing.	Value per kg. of dressed weight (best at 32 cents).	Value per 100 kg. live weight, including hide, etc.	Relative value of animals on basis of 100.	Value per 1,000 kg.		Difference in value of animals per 1,000 kg. initial live weight before and after fattening.
	Nitrogenous.	Non-nitrogenous.*							After fattening.	Before fattening.	
	Kg.	*Kg.*	*Kg.*	*Kg.*		*Cents.*					
Lot 1. ration below normal	2.73	12.75	551.75	2.003	58.9	$29\frac{1}{4}$	$18.84	89.4	$226.13	$144.00	$82.13
Lot 2. normal ration (Wolff)	2.73	16.40	533.70	2.294	60.9	$30\frac{1}{2}$	20.23	96.0	248.74	144.00	104.74
Loss from the poorer ration				0.291	2.0	$1\frac{1}{4}$	1.39	6.6			22.61
Difference in cost of two rations											8.76
Net loss as compared with normal ration											13.85

* Including fat × 2.5.

The effect of the ration deficient in nitrogen-free nutrients was noticeable in the diminished gain in live weight, the greater shrinkage in dressing, lower value per kilogram of dressed weight and per 100 kg. of live weight, and in the lower net profit. The authors remark that although it is true that the greater part of the increased value from the more liberal feeding goes into the butcher's pocket, since the loss from shrinkage in dressing is less, the better meat sells more readily at a good price, and the producer has a share in the gain.

(2) *Trials with rations richer in nitrogen-free nutrients than Wolff's.*—Four separate experiments are reported with sheep, made at Winningen, Emersleben, Queiss, and Hessen. In the latter experiment wet sugar-beet diffusion residue was fed in amounts ranging from 80 to 100 kg. per 1,000 kg. live weight. The results follow:

Effect of increasing nitrogen-free nutrients over Wolff's normal rations.

	Nutrients fed per 1,000 kg. of initial live weight.		Live weight per animal at beginning.	Average daily increase per 1,000 kg.	Per cent of live weight retained in dressing.	Value per kg. of dressed weight (best at 27⅓ c).	Value per 100 kg. live weight, including hide, etc.	Relative value of animals on basis of 100.	Value per 1,000 kg.		Difference in value of animals per 1,000 kg. initial live weight before and after fattening.
	Nitrogenous.	Non-nitrogenous.*							After fattening.	Before fattening.	
Winningen, 1892.											
	Kg.	*Kg.*	*Kg.*	*Kg.*		*Cents.*					
Lot 1, ration in excess of normal	3.54	18.9	42.03	3.736	58.2	26⅔	$17.51	97.2	$240.00	$115.20	$124.80
Lot 2, normal ration (Wolff)	3.54	16.5	42.45	3.557	54.6	26⅔	16.42	91.0	222.55	115.20	107.35
Gain from the larger ration				0.179	3.6		1.09	6.2			17.45
Increased cost of larger ration											5.76
Net gain from larger ration											11.69
Emersleben, 1892.											
Lot 1, ration in excess of normal	3.40	20.3	44.96	3.194	54.2	25.2	15.19	90.4	200.50	115.20	85.30
Lot 2, smaller ration	3.40	18.2	43.92	2.906	52.4	25.9	15.10	89.7	194.86	115.20	79.66
Gain from the larger ration				0.288	1.8	—0.7	0.09	0.7			5.64
Increased cost of larger ration											5.04
Net gain from larger ration											0.60
Queiss, 1892.											
Lot 1, ration in excess of normal	5.18	20.70	38.73	3.873	54.3	26.2	15.84	93.9	219.77	115.20	104.57
Lot 2, smaller ration	5.18	18.10	38.45	4.062	51.8	24.7	14.48	85.2	203.86	115.20	88.66
Gain from the larger ration				—0.189	+2.5	+1.5	1.36	7.7			15.91
Increased cost of larger ration											6.24
Net gain from larger ration											9.67
Hessen, 1890.											
Lot 1, 80 kg. diffusion residue†	3.70	15.9	47.2	3.454	53.2	26.6	16.75	95.1	220.90	115.20	105.70
Lot 2, 100 kg. diffusion residue	3.70	15.6	48.2	2.697	53.0	26.6	16.22	92.1	204.55	115.20	89.35
Lot 3, 100 kg. diffusion residue	3.70	18.5	48.8	3.095	56.3	27.4	19.08	98.9	227.95	115.20	112.75
Gain of lot 3 over lot 2											23.40
Increased cost											6.96
Net gain of lot 3 over lot 2											16.44
Net gain of lot 1 over lot 2											15.35

* Including fat × 2.5.

† Per 1,000 kg. live weight.

The gain in live weight was noticeably higher in the first two experiments where the nitrogen-free materials were in excess of Wolff's standards. In the third experiment, however, the gain was about 5 per cent less on the fuller ration.

The shrinkage in dressing was smaller in all three experiments on the ration containing the largest amount of nitrogen-free nutrients.

The value per kilogram of dressed mutton was no higher in the first

two experiments on the rations richest in nitrogen-free nutrients; but in the third experiment it was 1½ cents higher. It is not believed that this was an accidental occurrence. Experiments further on show a similar result when the nitrogen-free nutrients were increased still more. The animals become too fat, and as a consequence the value of the mutton decreases proportionally. In the third experiment this excessive fat formation may have been prevented by the large amount of protein fed.

The financial result, as shown in the last column, was best on the rations richest in nitrogen-free nutrients, although in the second experiment the balance was very small. In the first experiment this increased value of the total product was due to the greater gain in weight, and in the third to the greater value of the increase per kilogram.

While these experiments do not warrant any broad conclusions, they serve as the basis for further studies.

In the experiment at Hessen, increasing the amount of sugar-beet diffusion residue from 80 to 100 kg. per day and per 1,000 kg. live weight proved disadvantageous to the gain and the value of the product. In the case of lot 3, however, the ill effects of 100 kg. of wet diffusion residue were overcome by feeding a larger quantity of nitrogen-free nutrients in addition. This fact has no practical value, since the net result with lot 1, with less diffusion residue and less nitrogen-free material, was equally as good as in the case of lot 3. The results corroborate what the authors have found on previous occasions, that the consumption of an excessive amount of water is disadvantageous to the production of live weight and should therefore be avoided. If, however, large quantities of wet feeding stuffs are to be fed, the above experiment indicates that the nitrogen-free nutrients in the ration should also be increased.

In cases where the nitrogen-free nutrients were increased 21.3 and 23.3 kg., respectively, per 1,000 kg. live weight, without changing the nitrogenous nutrients, the average daily gain was invariably smaller, the loss in dressing was greater, the product was rated lower, and a financial loss resulted. These results indicate that in the interest of both quantity and quality of product the nitrogen-free material should not be increased beyond a certain limit, which the above experiments indicate to be 20 kg. daily per 1,000 kg. live weight. This amount the authors regard as the extreme limit. On the other hand the indications are that an amount in excess of that called for by Wolff's standards (16.2 kg.) may be fed with advantage as to quantity and quality of product and financial result.

That the unfavorable result with unusually large amounts of nitrogen-free materials was not due to a too small ration of protein is indicated by the trial at Queiss, where a ration of 5.18 kg. of protein per 1,000 kg. live weight did not prevent a lower gain in weight and an inferior quality of the product.

Effect of increasing the protein ration on the gain in weight and the quality of the dressed product.—These experiments were with oxen and sheep.

The increase in protein was made by increasing the amount of cotton-seed meal or peanut meal. In calculating the net gain, allowance is made for the increased value of the manure.

The results were as follows:

Results of increasing protein in rations.

	Nutrients fed per 1,000 kg. of initial live weight.		Live weight per animal at beginning.	Average daily increase per 1,000 kg.	Per cent of live weight retained in dressing.	Value per kg. of dressed weight (best†.)	Value per 100 kg. live weight, including hide, etc.	Relative value of animals on basis of 100.	Value per 1,000 kg.		Difference in value of animals per 1,000 kg. initial live weight before and after fattening.
	Nitrogenous.	Non-nitrogenous.*							After fattening.	Before fattening.	
	Kg.	*Kg.*	*Kg.*	*Kg.*		*Cents.*					
OXEN.											
Schlanstedt.											
Lot 2, ration richer in protein	3.64	16.40	542.0	2.503	61.8	31.7	$21.10	96.9	$263.93	$144.00	$119.93
Lot 3, normal ration (Wolff)	3.73	16.40	553.7	2.294	60.9	31.7	21.07	96.0	257.78	144.00	113.78
Gain from richer ration	......	....	....	0.209	0.9	......	0.3	0.9	....	....	6.15
Net gain from richer ration	......	....	....	....	......	......	....	......	....	....	3.52
SHEEP.											
Hornburg.											
Lot 1, ration richer in protein	4.00	19.9	32.72	4.424	54.1	25.2	15.29	90.7	234.29	115.20	119.09
Lot 2, ration poorer in protein	3.73	19.9	33.82	3.990	54.2	24.7	15.14	89.1	224.06	115.20	108.86
Gain from richer ration	......	....	....	0.434	—0.1	0.2	0.15	1.6	....	....	10.23
Net gain from richer ration	......	....	....	....	......	......	....	......	....	....	7.64
Siegersleben.											
Lot 1, ration richer in protein	4.19	18.95	41.45	4.123	57.0	26.9	15.96	98.0	239.57	115.20	124.37
Lot 2, ration poorer in protein	3.56	18.95	43.40	3.679	55.4	26.9	15.29	95.4	225.84	115.20	110.64
Gain from richer ration	......	....	....	0.544	1.6	......	0.67	2.6	....	....	13.73
Net gain from richer ration	......	....	....	....	......	......	....	......	....	....	12.18
Queiss, 1890.											
Lot 1, ration richer in protein	4.00	20.00	36.8	4.647	55.0	24.5	15.89	89.7	232.80	115.20	117.60
Lot 2, ration poorer in protein	3.30	20.00	37.9	4.354	55.7	25.2	16.46	92.3	236.04	115.20	120.84
Gain or loss from richer ration	......	....	....	+0.293	—0.7	—0.7	—0.57	—2.6	....	....	—3.24
Net loss from richer ration	......	....	....	....	......	......	....	......	....	....	—5.26
Oschersleben.											
Lot 1, ration richer in protein	3.51	16.15	50.25	3.062	57.5	26.6	16.63	99.0	217.15	115.20	101.95
Lot 2, ration poorer in protein	3.03	16.15	48.85	3.266	55.6	26.2	16.18	96.2	214.51	115.20	99.31
Gain from richer ration	......	....	....	—0.204	1.9	0.4	0.45	2.8	....	....	2.64
Net gain from richer ration	......	....	....	....	......	......	....	......	....	....	1.25

* Including fat × 2.5.

† At 32.4 cents for beef and 27.4 for mutton.

Results of increasing protein in rations—Continued.

	Nutrients fed per 1,000 kg. of initial live weight.		Live weight per animal at beginning.	Average daily increase per 1,000 kg.	Per cent of live weight retained in dressing.	Value per kg. of dressed weight (best).†	Value per 100 kg. live weight, including hide, etc.	Relative value of animals on basis of 100.	Value per 1,000 kg.		Difference in value of animals per 1,000 kg. initial live weight before and after fattening.
	Nitrogenous.	Non-niteogenous.*							After fattening	Before fattening.	
SHEEP—Continued.	*Kg.*	*Kg.*	*Kg.*	*Kg.*		*Cents.*					
Anderbeck.											
Lot 1, ration richer in protein	4.65	21.20	37.41	3.170	60.8	28.6	17.21	......	226.68	115.20	111.48
Lot 2, ration poorer in protein	3.99	19.95	37.51	3.237	59.6	26.6	17.11	95.6	226.54	115.20	111.34
Gain or loss from richer ration				—0.067	+1.2	+0.2					+.14
Net loss from richer ration											—4.79
Hessen.											
Lot 1, ration richer in protein	4.57	18.25	43.50	3.367	54.1	26.6	15.96	95.4	211.75	115.20	96.55
Lot 2, ration poorer in protein	3.43	16.00	43.57	2.479	55.0	26.4	16.08	96.1	200.78	115.20	85.58
Gain from richer ration				0.888	—0.9	0.2	—0.12	—0.7			10.97
Net gain from richer ration											2.26

*Including fat × 2.5. †At 32.4 cents for beef and 27.4 for mutton.

In the experiment with oxen, the feeding of a ration richer in protein than Wolff's standard resulted in a larger gain in weight, less shrinkage in dressing, and a somewhat better financial result, although the dressed beef was all valued at the same price per kilogram.

In the experiments with sheep, omitting the last two in which the nitrogen-free material was also increased, the increase of protein was as a rule favorable to the gain in weight. In several instances the loss in dressing was less, but it will be seen that in this respect increasing the nitrogen-free nutrients, within certain limits, had a more marked effect. In two cases the value of the mutton produced on the richer ration was rated higher, in one lower, and in another just the same. The results in this connection were no more marked or uniform than in the trials with nitrogen-free nutrients.

In the experiment at Anderbeck, in which both the protein and nitrogen-free nutrients were increased, the latter beyond the limit (20 kg.) mentioned above, there was no increased gain in weight on the richer feeding, but rather a less gain, as was expected. The quality of the mutton was somewhat better and the shrinkage in dressing less, but these did not prevent a lower financial result than where the poorer ration was fed.

The experiment at Hessen, however, shows that an increase of both nitrogenous and non-nitrogenous nutrients, within limits regarded as safe, may result favorably.

Experiments with variable amounts of nutrients in different periods.—These were with sheep, and covered two years. In one series one lot receiving 4.18 kg. of protein in the first period, 3.16 kg. in the second, and 4.29 kg. in the third, was compared with a lot receiving 4.32 kg. during the whole trial; and in a second series one lot receiving 3.73 kg. in the first period, 4.6 kg. in the second, and 3.73 kg. in the third, was compared with a lot receiving 4.6 kg. the whole time. In the one case the feeding in the middle period was the poorest, and in the other the richest. In both cases the gain in weight was largest in the case of the lots receiving the richer ration the entire time, the increased gain ranging from 0.36 kg. to 0.56 kg. daily per 1,000 kg. live weight. The value of the dressed product, on the other hand, was noticeably higher in case of the lots receiving the variable rations; and the loss in dressing was also slightly less. It would seem from this that the quality was improved by varying the composition of the ration from period to period.

Comparison of fattening superior and inferior oxen.—There were six oxen of each class. The inferior animals were the lighter in weight by about 65 kg. They were divided into three lots, receiving rations containing different proportions of nutrients. The poorest ration given these inferior animals was about the same as that given the better animals. The result of the feeding was that the inferior and lighter animals made the larger gain in live weight, those on the richest ration making the largest gain; but the financial result was on the side of the superior animals, for the product was rated much higher and their food was less expensive. The increased value due to the fattening was $21.76 more per 1,000 kg., live weight, in the case of the better animals than in the case of the lot of inferior animals making the best showing.

The authors conclude from these results that it is useless to attempt to secure a good result with inferior animals by intensive feeding. The first point in fattening animals is to use only animals of the best quality. With an equal expenditure for food, the result is so far superior with better animals that it can not be too strongly urged that only the better animals be selected for fattening.

Value of ensiled beet leaves for fattening.—The prevailing opinion in Germany is that the fresh leaves of the sugar beet possess a high feeding value, but there is a difference of opinion as to their value for fattening when ensiled, although the ensiled leaves are generally prized as a food for milk production. Trials were made with oxen and with sheep. In the single trial with oxen, 40 kg. of sugar-beet diffusion residue was compared with 30 kg. and 37.5 kg. of ensiled beet leaves, respectively. The diffusion-residue ration and the smaller ration with ensiled leaves contained approximately equal amounts of nutrients. The larger ration contained about 1 kg. more of nitrogenous and of non-nitrogenous material. The gain in weight, value of the slaughtered product, and increased value due to the feeding were all very considerably less on the

beet leaves, even where the heavier ration was fed. The inference is that the feeding value of ensiled beet leaves is not as high as the analysis would indicate, which is probably accounted for by the fact that the nitrogenous material in them consists for the greater part of amide compounds and that the percentage of digestible albuminoids is very low, as has been found by Stutzer and at the Halle Station. There is also some doubt as to the actual value of the nitrogen-free material, which is said to consist largely of butyric acid, lactic acid, and similar fermentation products. Another controlling factor is believed to be the excessive quantities of water which were consumed on beet leaves. The high salt content and the fermentation products of the ensiled leaves caused the animals to drink large quantities of water, which is believed to exert an influence on both the quantity and quality of the product.

Two series of experiments were made with sheep—one at Peseckerdorf and the other at Siegersleben. In the first 40 kg. of diffusion residue per 1,000 kg. live weight was compared with 50 and 60 kg. of ensiled beet leaves, respectively; and in the second, 30 kg. of diffusion residue was compared with 50 and 54 kg. of ensiled beet leaves, respectively.

In the first trial the result was analogous to that with oxen. The gain in live weight was less, the shrinkage in dressing was greater, the dressed product was rated lower, and, as a result, the financial result was less favorable on ensiled beet leaves than on diffusion residue.

In the second trial with sheep the concentrated food was increased, giving a richer ration. In this case the result was more favorable. When the rations of the two materials contained like amounts of nutriments the result agreed with the two previous trials—*i. e.*, the gain in weight was less, the loss in dressing was greater, and the quality was inferior on ensiled beet leaves. When 54 kg. of leaves was fed in place of 30 kg. of diffusion residue, and a larger quantity of protein fed in the concentrated foods, the gain in weight was better, the shrinkage less, and the quality of the product better than on diffusion residue.

The results of the two trials with sheep lead the authors to the statement that the feeding value of ensiled sugar-beet leaves is not equivalent to more than one half the digestible protein, which consists largely of amides, and two thirds of the nitrogen-free materials.

Effect of hay on the quality of the fattened animal.—The statement has been made that meat of the finest quality can not be produced without hay. A test of this question with sheep, in which the hay of a ration was replaced by pea vines, was made. The ration without hay was somewhat richer in all nutrients than the hay ration. The gain in weight was very slightly larger, the shrinkage smaller, and the value of the mutton per kg. one half cent less on the ration without hay. But the quality of the mutton produced without hay was regarded as unusually good.

Effect of various wet foods on the quality of beef.—Three wet foods were compared, namely, wet diffusion residue, distillery slop, and an artificial distillery slop made of steamed potatoes and hot water. These were each fed in connection with hay, straw, and grain. The rations all contained like amounts of nutrients. The largest gains were made on the diffusion residue and the distillery slop, respectively; but the mutton from artificial distillery slop was valued 2½ cents higher than that from distillery slop and 1½ cents higher than that from diffusion residue.

The authors believe that the result of this single experiment agrees with the observations in practice, as far as the value of distillery slop for fattening is concerned. The excessive amount of water in this slop appears to be unfavorable to meat production as regards both quantity and quality.—E. W. A.

Contagious foot rot in sheep, G. T. Brown (*Jour. Roy. Agr. Soc. England, 3 (1892), No. 10, pp. 276–291; and 4 (1893), No. 14, pp. 429–431*).—An orchard at Harrow which had not been grazed by sheep for many years was divided into three pens. In one pen were placed 2 sheep affected with foot rot and 4 sound sheep; in each of the other pens 2 sound sheep were placed. All of the sound sheep in pen 1 and 2 of the lambs born in that pen contracted the disease. The sheep in pens 2 and 3, under the same condition as those in pen 1, except that they had not been in contact with diseased animals, remained healthy.

August 31 the diseased sheep were taken from their pasture and two days later 3 sound sheep were put in this enclosure. On September 13 one of these was lame, and on September 19 another. The third remained healthy up to September 23, when she was turned into another pasture with a number of diseased sheep; foot rot developed October 2. Two other sound sheep placed in a pasture with diseased sheep September 19, contracted foot rot October 9 and 11. A sound ewe had been kept in an uncontaminated pen, which was very low and which became a quagmire. She showed lameness, but was free from foot rot when, November 14, she was turned into pasture with diseased sheep; she failed to contract foot rot up to the date of slaughter, in the following February.

At Denham 10 sheep from a farm where foot rot had never been known were placed, July 23, in pens or pastures. Two sound sheep were kept on concrete floors with diseased sheep; 2 sound sheep and 2 diseased sheep were placed in a well-drained orchard, and 6 sound sheep were pastured on a low, damp meadow. October 6 the sound sheep on the concrete floor and in the orchard had contracted the disease. All the sheep on the damp meadow remained sound. Two of the latter were sent to Harrow and put on pasture with diseased sheep. There both became lame. A lamb which for months ran with several sheep affected with chronic foot rot showed no signs of the disease.

The author draws the following conclusions:

So far as the evidence goes it justifies the statement that foot rot is a contagious disease; the infective matter being active when brought in contact with the skin between the claws, or when introduced into the system by inoculation, and probably when taken in by the mouth from contaminated pastures.

It can not be produced by long-continued exposure to undrained moist soils with an abundant coarse and wet herbage.

Animals exposed to these conditions for many months, and resisting entirely the influences named above, contract foot rot in from fourteen to twenty-one days on being placed among sheep suffering from the disease.

Sheep affected with foot rot may improve, and from time to time become worse; and finally may recover and present a perfectly healthy condition of foot, notwithstanding that they have been kept the whole period under the conditions which induced the disease.

The contagium of foot rot remains for some time in the system (ten to twenty days and longer) without any indication of disease appearing in the skin between the claws. An infected sheep may therefore escape detection even by an expert, and may introduce foot rot into a sound flock.

The author recommends the use of a mixture of one part pure carbolic acid and ten parts of glycerin, to be applied to the skin and allowed to run between the claws. A large flock may be driven twice a week over a dry floor covered with powdered lime, or through a trough containing a solution of one part of carbolic acid with fifty parts water in which a little soft soap is dissolved.

In an experiment the following year sound sheep were placed on a short dry pasture which had been occupied by diseased sheep the preceding year. They showed no evidence of foot rot, but some of the sheep showed a rise of temperature at an early period of the experiment, from which it was concluded that some infective matter had been taken into the system—J. F. D.

The nuclein content of human milk and cows' milk, SZONTAGH (*Ungar. Arch. Med., 1892, p. 192; abs. in Chem. Centbl., 1893, I, No. 22, p. 985*).—By digesting casein from cows' milk with artificial pepsin solution the author obtained a nuclein with a phosphoric acid content ranging from 2.97 to 3.5 per cent. By continued digestion of the nuclein with pepsin solution the nuclein diminished in quantity, and phosphoric acid could be recognized in the solution. This led the author to suspect that the nuclein was disassociated. Nuclein was also obtained by digesting milk directly with hydrochloric acid of the strength occurring in digestive fluids. Both methods of treatment, however, failed to yield nuclein from human milk, and the author was unable to separate nuclein from human milk by any method familiar to him. He concludes, therefore, that the casein of human milk is not like that of cows' milk, a nucleo-albumen.—E. W. A.

The separation of fat in sterilized milk, RENK (*Arch. Hyg., 17, pp. 312–323*).—The author mentions the familiar fact that sterilized milk often undergoes a change after being kept awhile, the fat globules uniting with each other to form large drops of fat, so that when the

milk is warmed these drops collect at the surface, often forming a layer of fat. After it has passed from a state of emulsion, this fat can not be made to mix with the milk as before, either by heating, shaking, or both. This change in the character of the milk is believed to affect its digestibility, especially for infants. It has been stated that the digestibility of milk by infants depends largely on the size of the fat globules, that with smaller globules being most easily digested. When the fat has passed from a state of emulsion its resorption becomes a more difficult matter, and may cause serious disturbance.

The author describes a number of experiments made to study this separation of the fat in sterilized milk. These trials, without exception, showed that with keeping a part of the fat of the milk changed from a state of emulsion and collected at the surface, gradually forming drops of fat. During the first week after sterilizing, the change was slight, but it increased as time went on, which is believed to indicate that the separation was not caused by the heat in sterilizing. At the end of a month about one fourth of the total fat in the milk had separated. In some trials the change was even greater.

The indications were that the change was not due to the action of bacteria.

The inference from these trials is that sterilized milk for children should be used while fresh, and the author believes the Soxhlet method of treating milk to be the best for this purpose.—E. W. A.

The relation of phosphates and casein to the souring of milk, H. TIMPE (*Chem. Ztg. 17, (1893), No. 43, pp. 757, 758*).—The presence of free lactic acid in milk is injurious to the growth and action of *Bacillus acidi lactici*, one of the most common forms of bacteria occurring in sour milk. In order that the fermentation may continue, the lactic acid formed must be neutralized in some way. This the author believes is done by the phosphates and the casein of the milk. The phosphates give up a part of their bases to the lactic acid formed, leaving monobasic phosphates which do not hinder the fermentation. The casein which is said to be combined with lime gives up its lime to the lactic acid, and further than this, as the author has found by experiment, is itself capable of combining with a certain quantity of lactic acid. In this way the author is able to account for the disposal of all the lactic acid formed during souring, so that the percentage of free lactic acid in the milk remains exceedingly small.—E. W. A.

Formation of fat during the ripening of cheese, H. JACOBSTHAL (*Pflüger's Arch. Physiol., 54, No. 7, 8, and 9, pp. 484–500*).—The question of the formation of fat from albuminoids has been a prominent one with physiologists for many years. An argument frequently cited to prove that such a formation may take place is the observation of Blondeau * that the fat increases in the ripening of Roquefort cheese.

*Ann. Chim. et Physik, 1864, p. 208.

Blondeau found 1.85 per cent of fat in fresh cheese, 16.12 per cent in cheese one month old, and 32.31 per cent in cheese two months old, and concluded that there had been a formation of fat from the albuminoids. Since his experiments, studies on this subject have been reported from various sources, some favoring Blondeau's view and some opposing it. Those by Brassier and Duclaux, for instance, indicated that there was either absolute decrease of fat during ripening, or no considerable change in the fat; while those by Kemmerich showed a marked increase in fat. Sieber, although he noticed a relative increase in the fat as the cheese aged, explained it by a loss of water.

In the present experiments the author used fresh white cheese ("*Quarkkäse*"), unusually poor in fat. Duplicate samples were weighed out and the total amount of fat determined with ether, in the one immediately and in the other after ripening. The average of four tests showed 100 grams of green cheese to contain in green state 2.24 grams and in ripe state 2.51 grams of fat, an absolute increase during ripening of 12 per cent. A second series of experiments, made in a similar manner with cheese broken into fine pieces, showed an average absolute increase of 17 per cent of fat. A third series, in which the ether extraction was carried on for a longer time, as it was suggested the ether might extract the fat from the ripe cheese more rapidly and completely, showed an absolute increase of fat of 31 per cent in seven days and nearly 100 per cent in fourteen days.

All of the experiments indicated that under favorable conditions the ether extract may increase absolutely during the ripening of cheese. The question arose as to the cause of this increase and the source of the fat (ether extract). A thorough study was then made of the ether extract, and the extracted cheese was examined for soaps and lactates. These studies showed that the increase in ether extract was not due to decomposition products of albuminoids for, although there was more nitrogen in the extract from ripe cheese than green cheese, there was not nearly enough to account for the increased ether extract. It was found that the increase was mainly in the fatty acids, as shown by the following:

Fats and fatty acids in 100 grams of cheese.

	When green.	After ripening.
	Grams.	*Grams.*
Neutral fat	0.8509	0.9295
Fatty acids	0.2280	1.2231

These fatty acids are formed, the author believes, through the agency of fungi or bacteria which cause the ripening processes. It is well known that fungi are able to form fat from a wide range of substances—organic salts, asparagin, leucin, pepton, sugar, etc. The author suggests, therefore, that in the case of ripening cheese they form fat synthetically from the constituents of the cheese, especially the casein.

The conclusions of the author from his experiments are as follows:

(1) In the ripening of cheese an increase takes place in the ether extract which is largely accounted for by the increase in the fatty acids.

(2) The fat formation is not a characteristic of the ripening, but merely an accompanying process taking place to a greater or less extent, according to circumstances. It is due to the activity of the fungi cells.

(3) The fungi produce neutral fat synthetically from the constituents of the cheese in which they grow. Later this neutral fat is saponified, yielding fatty acids.

It is explained that since this formation of fat is attributable to fungi it furnishes no ground for evidence that a formation of fat from albuminoids can take place in the animal body.—E. W. A.

Studies on the ripening of cheese, and especially on the production of pores in cheese, F. BAUMANN (*Landw. Vers. Sta., 42, No. 3, 4, and 5, pp. 181–214*).—The author made a thorough study of this subject, using sterilized rennet and milk. The milk at his disposal was ordinary market milk, containing bacteria in large numbers. He found that heating it for two hours at 70° C. killed about 99.5 per cent of the microörganisms, which rendered the milk sufficiently sterile for his purpose. Freshly prepared rennet solution was found to contain nearly one and one half million germs to the cubic centimeter. It was sterilized by heating at 58.5° C. for four and one half hours on six consecutive days. By this process the rennet lost about 43.5 per cent of its strength.

The formation of holes in ripening cheese received especial attention. This was found to be due to the production of gases, chiefly carbonic acid and hydrogen. The organism causing it was isolated and studied and named *Bacillus diatrypeticus casei.* In milk cultures this bacillus produced alcohol, volatile fatty acids, lactic acid (probably at the expense of the milk sugar), and peptones from the proteids. As no volatile fatty acids were produced in fat-free cultures the inference is that these come from the breaking up of the milk fat. Products were found which, from their chemical composition, appeared to be intermediate products between proteids and peptones.

Cheese made from milk which had been inoculated with *Bacillus diatrypeticus casei* showed after forty-eight hours a much larger production of holes than similar cheese from uninoculated milk. Experiments on white mice and guinea pigs showed the bacillus to be non-pathogenic.

As to the manner in which this particular bacillus gets into the milk, it was decided that the most probable medium was through the food and the excrement. The bacillus was not found in the duct at the end of the teats but was found in garden soil, yeast cake, spoiled rape cake, drainage water, stagnant water, old meat, and cow dung.

Trials in making cheese from milk inoculated with this bacillus alone and in company with bacilli which did not produce gas showed that *Bacillus diatrypeticus casei* might be entirely suppressed by other bac-

teria, in which case a solid cheese without holes resulted. In other cases, where pasteurized milk was inoculated with the bacillus in question, the cheese had to be cut open in three days, as it had already cracked open in several places, so powerful was the generation of gases.

This suggests a possible cause of certain forms of abnormal ripening of cheese observed in practice. As the bacillus described was found in milk cultures to develop free fatty acids, it is quite possible that the bitter, unpleasant taste often noticed is due to an unusual activity of this bacillus.

The author's summary from his studies is as follows:

(1) The importance of the bacteria in rennet in the fermentation and ripening of cheese is less than is usually attributed to them.

(2) Neutral or slightly acid rennet solutions may be sterilized by fractional heating, but lose thereby about one half in strength.

(3) It is impossible to sterilize market milk without taking away its power to "cheese."

(4) The formation of holes or pores in hard cheese is due principally to the action of a single bacillus, which received the name *Bacillus diatrypeticus casei*. This bacillus may render cheese normally or abnormally porous, according to the circumstances.

(5) The gas generated, and to which the production of the pores is due, consists principally of carbonic acid gas (63 per cent) and hydrogen, together with admixtures of small quantities of other gases, but no hydrocarbons.

(6) As a result of the fermentation induced by the above bacillus alcohol is formed.

(7) The superior character of the Swiss Emmenthaler cheese is due not so much to the aromatic food of the Alpine pastures or the use of milk richer in fat, as to the fact that the relative number of the different kinds of bacteria in the milk is less variable and the methods of cheese-making better adapted to a mixture of the bacteria in the milk.—E. W. A.

TITLES OF ARTICLES IN RECENT FOREIGN PUBLICATIONS.

CHEMISTRY.

An apparatus for the uninterrupted determination of the specific gravity of liquids (*Apparat zur ununterbrochenen Bestimmung des specifischen Gewicht von Flüssigkeiten*), J. V. von Divis.—*Ztschr. Ver. Rübenz.-Ind., 1893, pp. 555, 556; abs. in Chem. Centbl., 1893, II, No. 6, p. 313.*

A new mercury thermometer for temperatures up to 550° C. (*Ueber das neue Quecksilber-Thermometer für Temperaturen bis 550°*), M. von Recklinghausen.—*Ber. deut. chem. Ges., 26, pp. 1514–1517.*

An attachment for analytical balances to prevent losing the rider (*Ueber eine Reitersicherung an analytischen Wagen*), A. K. Markl.—*Ztschr. anal. Chem., 32, No. 4, pp. 431–433, figs. 3.*

Sartorius's new hydrostatic (Westphal) balance (*Sartorius' neue hydrostatische Waag und einige Hülfsmittel zur Bestimmung des specifischen Gewichts von Flüssigkeiten und festen Körpern*).—*Chem. Ztg., 17 (1893), No. 63, p. 1134, fig. 1.*

A stirring machine for use in precipitating phosphoric acid (*Rührwerk zur Fällung der Phosphorsäure*), A. Keller.—*Chem. Ztg., 17 (1893), No. 59, p. 1070.*

A new sulphureted hydrogen apparatus for analytical laboratories (*Ein neuer Schwefelwasserstoff-Apparat für analytische Laboratorien*), L. L. de Koninck.—*Chem. Ztg., 17 (1893), No. 61, pp. 1099, 1100.*

A test tube for making zone reactions (*Ein Reagensrohr zur Hervorrufung von Zonenreactionen*), E. Besemfelder.—*Abs. in Ztschr. anal. Chem., 32, No. 4, pp. 459, 460, fig. 1.*

On burettes and pipettes (*Ueber Büreten und Pipetten*).—A résumé, *Ztschr. anal. Chem., 32, No. 4, pp. 453–458.*

Note on a form of burette for rapid titration, L. Garbutt.—*Chem. News, 68 (1893), No. 1762, pp. 108, 109, fig. 1.*

The cause of the birotation of dextrose (*Ueber die Ursache der Birotation des Traubenzuckers*), B. Tollens.—*Ber. deut. chem. Ges., 26 (1893), p. 1799.*

The action of lime and alkalis on inverted sugar (*Einwirkung von Kalk und Alkalien auf Invertzucker*), L. Jesser.—*Neue Ztschr. Rübenz.-Ind., 31, pp. 3–11; abs. in Chem. Centbl., 1893, II, No. 6, p. 364.*

Determination of tannic acid, G. Fleury.—*Jour. Pharm. Anvers, 1892, p. 252; abs. in Chem. Centbl., 1893, II, No. 5, p. 299.*

The quantitative and qualitative determination of sugar with phenylhydrazin (*Ueber quantitative and qualitative Zuckerbestimmungen mittels Phenylhydrazin*), E. Laves.—*Arch. Pharm., 231, pp. 366–372; abs. in Chem. Centbl., 1893, II, No. 5, p. 298.*

The color reaction between phenylhydrazin and lignin (*Ueber die Farbenreaction zwischen Phenylhydrazin und Lignin*), E. Nickel.—*Chem. Ztg., 17 (1893), No. 67, p. 1209.*

Determination of volatile oils (*Die Bestimmung der ätherischen Oele*), F. Ranwez.—*Ann. Chem., 272, p. 99; abs. in Ztschr. anal. Chem., 32, No. 4, pp. 495–497.*

Determination of succinic acid (*Ueber die Bestimmung der Bernsteinsäure*).—A résumé, *Ztschr. anal. Chem., 32, No. 4, pp. 482–486.*

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The employment of barium hydrate in butter analysis (*Ueber die Verwendung von Bariumhydroxyd in der Butteranalyse*), E. LAVES.—*Arch. Pharm., 231, pp. 356–366; abs. in Chem. Centbl., 1893, II, No. 5, p. 298.*

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The effects of feeding the ration in one or several portions on the assimilation of the same (*Der Einfluss einmaliger oder fraktionierter Aufnahme der Nahrung auf die Ausnutzung derselben*), H. WEISKE.—*Ztschr. physiol. Chem., 18, pp. 109–111; abs. in Chem. Centbl., 1893, II, No. 10, p. 543.*

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The occurrence of ammonia in the contents of the stomach, and its effect on the determination of the hydrochloric-acid content of the stomach by recent methods (*Ueber das Vorkommen von Ammoniak im Mageninhalt und die Beeinflussung der neueren Salzsäurebestimmungsmethoden durch dasselbe*), H. STRAUSS.—*Berl. Klin. Wochenschr., 30, pp. 398–402; abs. in Chem. Centbl., 1893, II, No. 7, p. 379.*

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Analysis of milk and milk products, H. LEFFMAN and W. BEAM.—*Philadelphia: Blakiston, Son & Co., 1893, pp. 92.*

The determination of lactose in milk (*Dosage de la lactose dans les laits*), G. DENIGÈS.—*Rev. Internat. Falsif., 6 (1893), No. 11, pp. 190, 191; No. 12, pp. 210–212.*

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On the value of boiled milk (*Sur la valeur du lait bouilli*), FAYEL.—*Rev. Internat. Falsif., 6 (1893), No. 12, pp. 213, 214.*

The discovery of sulphur in cows' milk (*Schwefel in Kuhmilch*), A. SARTORI.—*Chem. Ztg., 17 (1893), No. 59, p. 1070, and No. 63, p. 1138.*

The source of the bacteria in milk, and their ability to increase (*Die Herkunft der Bakterien in der Milch und ihre Vermehrungsfähigkeit*).—*Schweiz. Milch Ztg., 19 (1893), No. 16.*

Experiments in ripening cream with a prepared "starter" (*Rahmsäuerungsversuche mit dem "Normal-Säurewecker" der Danish Butter Colour Co.*), KLEIN *and* KÜHN.—*Landbote, 14 (1893), No. 61, p. 611.*

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The relation of the phosphates and casein to lactic fermentation (*Ueber die Beziehungen der Phosphate und des Caseïns zur Milchsäure-Gahrung*), H. TIMPE.—*Arch. Hyg., 18, No. 1, pp. 1–34.*

Results of some casein and milk fermentation tests (*Einige Resultate von Milchgär- und Kaseïnproben*), F. J. HERZ.—*Abs. in Milch Ztg., 22 (1893), No. 32, pp. 523, 524.*

On goats' milk and its recognition in cows' milk (*Ueber Ziegenmilch und den Nachweis desselben in der Kuhmilch*), SCHAFFER.—*Landw. Jahrb. Schweiz, 6 (1892), pp. 69–72.*

Experiments in preserving milk samples for testing (*Versuche über die Konservierung der Milchproben welche zur Fettbestimmung dienen, ausgeführt an der Molkerei Lauterbach*), J. NEUMANN.—*Milch Ztg., 22 (1893), No. 32, pp. 526, 527.*

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A note on the Johannson butter extractor (*Note sur l'extracteur Johannson*), A. THEUNIS—*Bul. Agr. (Belgium), 1893; Rev. Agron., 1893, No. 1, pp. 57–61.*

Coöperative creameries in western France (*Laiteries coopératives a créer dans la région de l'Oust*), CATHELINEAN and SURCOOF.—*Ind. Lait., 18 (1893), No. 31, pp. 244–246; No. 32, pp. 252–254.*

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senschaftsmolkereien), VIETH.—*Landw. Vereinsschr. balt. Cent. Ver., 1893, No. 31, pp. 121–123.*

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Effect of exclusion of the air on the ripening of Emmenthaler cheese (*Ueber den Einfluss des Luftabschlusses auf die Reifung des Emmenthalerkäses*), E. VON FREUDENREICH and F. SCHAFFER.—*Landw. Jahrb. Schweiz, 6 (1892), pp. 62–67.*

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New cellulose derivatives and their industrial applications, C. F. CROSS, E. J. BEVAN and C. BEADLE.—*Jour. Soc. Chem. Ind., 12, No. 6, pp. 498–501.*

Dulcin, a new saccharine compound (*Dulcin, ein neuer Süssstoff*), A. STIFT.—*Wochenschr. Cent. Ver. Rübenz.-Ind., 31 (1893), No. 30, p. 471.*

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Purification of beet juices with chloride of iron (*Reinigung der Rübensäfte mit Eisenchlorid*).—*Abs. in Wochenschr. Cent. Ver. Rübenz.-Ind., 31 (1893), No. 30, p. 470.*

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The analysis of lubricating oils containing "blown" rape-seed and "blown" cotton-seed oils, T. B. STILLMAN.—*Jour. Am. Chem. Soc., 15, No. 5, pp. 265–270.*

Notes on rice oil and maize oil, A. SMETHAM.—*Analyst, 18 (1893), Aug., pp. 191–193.*

The manufacture of wood pulp for paper (*La fabrication de la pate de bois*), DUBOIS.—*Bul. Agr. (Belgium) 9 (1893), No. 2, pp. 132–136.*

AGRICULTURAL ENGINEERING.

The mechanics of plowing (*Ueber die Mechanik des Pflügens*), A. FOPPL.—*Landw. Jahrb., 22 (1893), No. 5, pp. 719–740.*

Plans for a large cow barn, stalls, and troughs (*Tierstall des Herrn Gutsbesitzers Stephan Melchers in Verne bei Salzkotten*).—*Deut. landw. Presse, 20 (1893), No. 55, pp. 589–591.*

The question of ventilation (*Zur Lehre vom Luftwechsel*), G. WOLFFHÜGEL.—*Arch. Hyg., 18, No. 3, p. 251.*

AGRICULTURAL STATISTICS.

An account of work done at the agricultural experiment station at Darmstadt, Germany (*Étude sur quelques stations agronomiques allemandes*), SAILLARD.—*Ann. Sci. Agron., 1892, II, No. 2, pp. 294–320.*

The agriculture of the Netherlands in 1890 (*Die niederländische Landwirtschaft im Jahre 1890*), H. GROHMANN.—*Landw. Jahrb., 22 (1893), No. 5, pp. 741–799.*

The agriculture of the United States of America (*Die Landwirtschaft in den Vereinigten Staaten von Nordamerika*), F. OETKEN.—*Berlin: Paul Parey. Price 10 marks.*

Agricultural statistics for Prussia for the year 1892, part I (*Beiträge zur landwirtschaftlichen Statistik von Preussen für das Jahr 1892, erster Theil*).—*Landw. Jahrb., 22 (1893), Supplement 1, pp. 366.*

Statistics of agricultural and similar schools in Prussia for the year 1892 (*Statistik der landwirthschaftlichen und zuverwandten Unterrichts-Anstalten Preussens nach dem Stande am Schlusse des Jahres 1892*).—*Landw. Jahrb., 22 (1893), Supplement 1, pp. 271.*

A suggestion in regard to the collection of statistics of animals in Switzerland (*Vorschlag betreffend den Ausbau der schweizerischen Viehstatistik*), E. LAUR.—*Landw. Jahrb. Schweiz, 6 (1892), pp. 300–310.*

The exportation of food stuffs and agricultural products from Belgium (*L'exportation des denrees et produits agricoles de Belgique*), H. ROLIN.—*Bul. Agr. (Belgium), 9 (1893), No. 2, pp. 197–206.*

EXPERIMENT STATION NOTES.

Michigan Station.—L. G. Gorton has been appointed director of the station. C. D. Smith has been appointed agriculturist, and F. B. Mumford assistant agriculturist. A. G. Gulley, for the past four years connected with the horticultural department of the agricultural college, has been appointed horticulturist to the Vermont Station.

New York Cornell Station.—E. G. Lodeman has been appointed assistant in horticulture vice F. W. Card, who resigned to become professor of horticulture in the University of Nebraska. A building for purposes of instruction and experimentation in dairying is being erected at a cost of $50,000, and will be ready for occupation about June 1, 1894. A special course in dairying has been instituted, to take place during the coming winter term, 1893–'94.

Japan.—Dr. O. Löew, formerly connected with the University of Munich, has been appointed professor of agricultural chemistry at the University of Tokio, Japan, in place of Dr. O. Kellner, who resigned some time since to become director of the experiment station at Möckern, Germany.

New Zealand.—As a preparation for arbor day, the department of agriculture, Wellington, New Zealand, printed and distributed circulars giving lists of trees suitable for planting. August 4 was the day set apart for arbor day. The New Zealand department of agriculture has begun to issue illustrated leaflets giving information on agricultural subjects. Leaflet No. 1 treats of the Hessian fly, No. 2 of the Bathurst bur (*Xanthium spinosum*), No. 3 of the horse bot fly, and No. 4 of the Canada thistle.

A new potato disease.—Prof. Kirchner, of Hohenheim, Germany, describes in *Württemb. Wochenbl. für Landw.*, a new disease recently noticed in that section which affects the tops of potatoes. He calls it a stem rot and attributes it to a fungus, *Botrytis cinerea.* A soft, discolored spot first appears on the stem near the surface of the ground or just under it, which later causes the whole plant to wilt and dry up. The tubers show no signs of disease, but of course fail to develop. When the plants are near together, a skinny coating of fungus growth of brownish gray color is often found on the diseased stems. The fungus can grow on dead vegetable matter, manure, etc., and under certain conditions on the stems of a variety of growing plants. Consequently the use of barnyard manure for potatoes is to be avoided where the disease prevails. As a further precaution it is recommended to gather and burn the tops as soon as the potatoes can be dug. At present the disease appears to be confined to a limited area.

Mouth and hoof disease.—At the suggestion of the German minister of agriculture, domains, and forestry, the royal technical deputation for veterinary science has published the following statement: The substance through which the infection of the mouth and hoof disease is carried is as yet unknown. A prize of $750 is hereby offered for the discovery and isolation of the same. The identity of the substance must be established beyond doubt by inoculating animals and producing the disease. Reports are to be made in writing by June 30, 1894, and demonstrations will be called for before awarding the prize. The reward will be made public January 1, 1895.

Tobacco injurious to cows.—The *Deutsche Meierei Zeitung* warns farmers against throwing the refuse from tobacco cutting where cows can get at it. It is said to be

a common practice among tobacco growers to use the waste for bedding cows or to throw it in the barnyard where the cows can readily get at it. The case is reported of a farmer who recently lost a cow which had eaten tobacco leaves. An examination showed nicotine poisoning.

DESTRUCTION OF SHEEP TICKS.—A correspondent in *Deut. landw. Presse* gives his experience in ridding sheep of ticks. A mercuric ointment affected the health of the lambs. Insect powder was too dear and its effect was not permanent. A wash of tobacco water has to be repeated. The writer's experience with a carbolic-acid wash was very favorable. It proved effective and durable. He used a preparation of carbolic acid especially prepared, to be dissolved in water.

FEEDING OAK LEAVES TO CATTLE.—In *Milch Zeitung* (*1893, No. 34*) there is a note on feeding oak leaves to cattle. The leaves used were covered with thick honey dew and many plant lice were present. A small percentage of the animals so fed became sick, but recovered in from eight to thirty days. One of them died.

SUNFLOWER CULTURE.—A correspondent in *Wien. landw. Ztg.* recommends the culture of sunflowers between rows of potatoes. To avoid shading the potatoes too much, sunflowers are planted only in every second, third, or fourth row, according to the width of the rows. The distance in the drill is 50 to 60 cm., about 20 to 24 inches. In order to produce large flower heads only one or two heads should be left on each plant.

The ripe flower disks, together with the tender portions of the plant, after being chopped, are mixed with clover or corn forage, and the mixture is said to be acceptable to cattle. The lighter kernels are used as food for poultry. From the heavier seeds a salad oil is expressed. The cake secured after the oil is expressed is an excellent food for milch cows. The hulls of the kernels are cooked with other food for swine. Seventeen bushels of clear seed yielded about 36 quarts of salad oil.

COMPOSITION OF BLACK LUPINE.—According to an article in *Deut. landw. Presse* (*1893, No. 42, pp. 459, 460*), the black-seeded lupine is supposed to have originated in Siberia. An analysis of the black lupine by Dr. S. Gabriel gave the following results in per cent of dry matter: Crude protein, 43.50 per cent; fat, 5.58; fiber, 15.91; nitrogen, free extract, 30.56; ash, 4.45. The water content was 16.41 per cent. These figures show the black lupine to be an extremely rich food stuff whose content of protein is equaled by but few plants.

An artificial digestion experiment by Dr. Gabriel gave 95.4 per cent as the digestion coefficient for the nitrogenous matters.

The use of lupines for feeding purposes is dependent on the amount of alkaloids present, which are injurious to animals. In the black lupine in 100 grams of dry substance there was only 0.15 gram of alkaloids. This small quantity, however, was sufficient to give the seed a distinctly bitter taste. This variety is poorer in alkaloids than most of the other varieties of lupines.

GROWING LEGUMES AND CEREALS TOGETHER.—S. La Flize presents in *Ann Sci. Agron.* (*1892, 1, No. 2, pp. 174–178*) an interesting theory concerning the nitrogen supply of grains when grown in a mixture with legumes. As the result of his experiments, conducted on a very poor field of the Rambouillet farm, he found that when crimson clover or a mixture of vetches and peas was sown with rye or barley the cereals made a fair growth without the application of any nitrogenous fertilizer.

He concludes that cereals grown with legumes profit by the nitrogen fixed by the legumes, and enough of nitrogen is secured in this way to give a fair harvest of grain without an additional application of nitrogen to the soil in the form of manures.

ADULTERATION OF BRAN.—A German miller was recently sentenced to two weeks in jail and to pay a fine of $75 for selling bran which, according to analyses of the Pommritz experiment station contained 28, 33, and 48 per cent of ground vegetable ivory. The adulterant was obtained by grinding the scraps from the manufacture of buttons, etc. As it consists almost entirely of cellulose, it is of little if any real

value for food. Frequent mention has been made by the European stations of its use in adulterating feeding stuffs, more especially brans. It lends itself readily to this purpose, being cheap and not easily detected by the naked eye.

EXPERIMENTS WITH VARIETIES OF SUGAR BEETS.—Variety tests covering a number of years are reported by the Halle Experiment Station in *Scheibler's neue Zeitsch. f. Rubenzuckerind* (*30, p. 25*). In these two principal types of beets were used, the Klein Wanzleben and the Vilmorin. Fifteen of the varieties tested belonged to the former type and eight to the latter. Every year from 1882 to 1892, inclusive, the amount of sugar produced on similar areas was greater for the Klein Wanzleben and similar varieties than for the Vilmorin and related varieties.

THE EFFECT OF ELECTRICAL CURRENTS ON BEET JUICE.—Experiments reported by W. Bersch in *Zeitsch. Zuckerind. und Landw.* (*1893, No. 1, pp. 43–69*) lead to the following conclusions:

The electrical current increases the purity coefficient of beet juice, and removes a considerable quantity of nitrogenous matter; the use of zinc electrodes gives zinc in solution, and the resulting juice is strongly alkaline; the capacity of the juice to reduce copper solutions is not increased by the use of zinc electrodes; the purifying effect of the electrical current is perceptibly increased when it acts on juice from which a part of the non-sugars have been removed by heating to 75° C., and then filtering; zinc combinations cause a very slight purification of juice; juice which has been treated with an electric current requires less lime in the subsequent operations than untreated juice; the electrical treatment also gives a higher color.

TEMPERATURE OF THE INTERIOR OF A BEET ROOT.—H. Briem reports an experiment in *Oesterr.-ungar. Zeitsch. Zuckerind. u. Landw.* (*1893, No. 1, pp. 15, 16*), in which one thermometer was placed in the air just above the surface of a field of sugar beets, another sunk about 4 inches in the soil near a beet, and a third inserted into the beet root to a depth of about 4 inches. The readings were taken three times daily. For the month of September the average readings of the three thermometers were: Air, 16.39° C.; soil, 16.12° C.; and interior of beet, 16.10° C.

LEGAY'S MILK "STERILISATOR."—An illustrated description of this apparatus is given in *Milch Ztg.* (*1893, No. 22, p. 360*). The apparatus consists of a vessel of from a pint to a quart capacity, into the neck of which a glass tube closed at one end is fastened air-tight by means of rubber rings. On the glass tube are two marks designated 75° and 80° C., respectively. The vessel is filled to a certain point with milk, and heated in a water or sand bath. The milk rises in the tube to 75°, and soon to 80°, when the heat is discontinued. The milk will retain its temperature of 75° to 80° for ten to twenty minutes. It is then rapidly cooled to 10° or 12° C. Milk pasteurized in this manner is said to remain fresh for three or four days.

An advantage of this apparatus is said to be that it allows no change in water content during treatment, as may take place where milk is heated in an open vessel. Legay found that when 200 grams of milk was boiled for forty seconds in a cylinder with an opening about 0.3 inch square, the weight was reduced by the evaporation of water to 144 grams, and that the specific gravity was raised from 1.037 at the beginning to 1.053. There is no change of specific gravity in using the Legay apparatus.

NATIONAL AGRICULTURAL SOCIETY OF FRANCE.—A pamphlet of 87 pages, published by this society, gives a brief mention of the most important papers on agriculture and related sciences contributed by the members, between July, 1892, and July, 1893. An interesting parallel is drawn between the agricultural conditions of the present dry year and those which confronted the French farmers in the drought of 1785.

PRIZES FOR PRESERVED DAIRY PRODUCTS.—At the next annual fair of the German Agricultural Society, which will be held in Berlin in 1894, prizes are to be offered for preserved dairy products of the following classes: (1) Noncondensed milk and cream; (2) condensed milk and cream; (3) milk powder; (4) butter; (5) cheese. Besides these, the Bremen Chamber of Commerce will also offer a silver medal for butter.

LIST OF PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE.

AUGUST AND SEPTEMBER, 1893.

Report of the Secretary of Agriculture for 1892.
Indian Corn in the Manufacture of Beer.
DIVISION OF CHEMISTRY:
 Bulletin No. 13, part VIII.—Foods and Food Adulterants—Canned Vegetables.
DIVISION OF ENTOMOLOGY:
 INSECT LIFE, vol. V, No. 5, July, 1893.
 Bulletin No. 31.—Catalogue of the Exhibit of Economic Entomology at the World's Columbian Exposition.
DIVISION OF STATISTICS:
 Report No. 107 (new series), August, 1893.—Report of the Statistician.
 Report No. 108 (new series), September, 1893.—Report of the Statistician.
OFFICE OF IRRIGATION INQUIRY:
 Bulletin No. 1.—Abstract of the Laws of the Several States and Territories on Irrigation and Water Rights.
OFFICE OF EXPERIMENT STATIONS:
 Experiment Station Record, vol. IV, No. 9, April, 1893.
 Experiment Station Record, vol. IV, No. 10, May, 1893.
 Experiment Station Record, vol. IV, No. 11, June, 1893.
 Bulletin No. 16.—Proceedings of the Sixth Annual Convention of the Association of American Agricultural Colleges and Experiment Stations, held at New Orleans, Louisiana, November 15–19, 1892.
WEATHER BUREAU:
 Monthly Weather Review, June, 1893.
 Monthly Weather Review, July, 1893.
 Bulletin No. 10.—The Climate of Chicago.
 Bulletin A.—Summary of International Meteorological Observations.

LIST OF STATION PUBLICATIONS RECEIVED BY THE OFFICE OF EXPERIMENT STATIONS.

AUGUST AND SEPTEMBER, 1893

AGRICULTURAL EXPERIMENT STATION OF THE AGRICULTURAL AND MECHANICAL COLLEGE OF ALABAMA:

Bulletin No. 48, July, 1893.—The Effect of Organic Matter on Natural Phosphates; Commercial Fertilizers.

CANEBRAKE AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 16, July, 1893.—Potatoes—Amounts of Seed.

Bulletin No. 17, July, 1893.—Grapes and some new Fruits.

COLORADO AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 23, April, 1893.—Colorado Weeds.

Bulletin No. 24, July, 1893.—A Few Common Insect Pests.

Bulletin No. 25, October, 1893.—Loco and Larkspur.

GEORGIA EXPERIMENT STATION:

Bulletin No. 21, August, 1893.—Practical Dairying; Dehorning Cattle; Feed Formulas; Experiments with Oats.

AGRICULTURAL EXPERIMENT STATION OF INDIANA:

Bulletin No. 45, August, 1893.—Field Experiments with Wheat; Forms of Nitrogen for Wheat.

IOWA AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 21, 1893.—Investigations in Cheese-making; Colt Feeding; Shrinkage of Wool; Time to Cut Corn; Sweet *vs.* Ripened Cream Butter; An Aromatic Bacillus of Cheese; Some Bacteriological Work in the Dairy; Impurities of Clover Seed.

KENTUCKY AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 46, August, 1893.—Commercial Fertilizers.

LOUISIANA STATE EXPERIMENT STATIONS:

Special Report.—Geology and Agriculture, part II.—A Preliminary Report upon the Hills of Louisiana.

MAINE STATE COLLEGE AGRICULTURAL EXPERIMENT STATION:

Annual Report, 1892, part IV.

Director's Report, 1892.

MARYLAND AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 21, June, 1893.—Soils of Maryland.

MASSACHUSETTS STATE AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 49, August, 1893.—Meteorological Summary for July, 1892-1893.

HATCH EXPERIMENT STATION OF THE MASSACHUSETTS AGRICULTURAL COLLEGE:

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Bulletin No. 96, July, 1893.—Honey Analyses.

Bulletin No. 97, July, 1893.—Fertilizer Analyses.

Bulletin No. 98, July, 1893.—Locusts; the Horn Fly.

Bulletin No. 99, July, 1893.—Michigan Soils.

MISSISSIPPI AGRICULTURAL EXPERIMENT STATION:
Bulletin No. 26, August, 1893.—Small Fruits.
NEVADA AGRICULTURAL EXPERIMENT STATION:
Bulletin No. 19, December, 1892.—Sugar Beets.
NEW YORK AGRICULTURAL EXPERIMENT STATION:
Bulletin No. 56 (new series), May, 1893.—Experiments in the Manufacture of Cheese.
Bulletin No. 57 (new series), June, 1893.—Feeding Experiments with Laying Hens.
Bulletin No. 58 (new series), July, 1893.—Analyses of Commercial Fertilizers Collected in Long Island in the Spring of 1893.
CORNELL UNIVERSITY AGRICULTURAL EXPERIMENT STATION:
Bulletin No. 54, June, 1893.—Dehorning.
Bulletin No. 55, July, 1893.—Greenhouse Notes.
NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION:
Bulletin No. 91*d*, July, 1893.—Investigations upon the Phosphoric Acid in Crude Fertilizing Materials, and upon Methods of Fertilizer Analysis.
Bulletin No. 91*e*, July, 1893.—Meteorological Summary for North Carolina, June, 1893.
Bulletin No. 92*a*, August 24, 1893.—Meteorological Summary.
NORTH DAKOTA AGRICULTURAL EXPERIMENT STATION:
Third Annual Report, 1892.
Bulletin No. 10, May, 1893.—Grain and Forage Crops.
OHIO AGRICULTURAL EXPERIMENT STATION:
Bulletin No. 49, May, 1893.—Field Experiments with Commercial Fertilizers.
Bulletin, vol. I, No. 3 (technical series), April, 1893.—Entomological and Botanical Papers.
OKLAHOMA AGRICULTURAL EXPERIMENT STATION:
Bulletin No. 6, May, 1893.—Notes of Progress; Analyses.
RHODE ISLAND AGRICULTURAL EXPERIMENT STATION:
Bulletin No. 23, July, 1893.—Fertilizers, Commercial and Miscellaneous.
Bulletin No. 24, August, 1893.—Analyses of Commercial Fertilizers.
SOUTH CAROLINA AGRICULTURAL EXPERIMENT STATION:
Bulletin No. 7, September, 1892.—Experiments with Oats and Wheat.
TENNESSEE AGRICULTURAL EXPERIMENT STATION:
Bulletin, vol. VI, No. 1, January, 1893.—Some Injurious Insects of the Apple.
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Bulletin No. 23, July, 1893.—Shelter of Stock; Exercise *vs.* Non-exercise of Stock; Early *vs.* Late Irrigation.
VERMONT STATE AGRICULTURAL EXPERIMENT STATION:
Sixth Annual Report, 1892.

DOMINION OF CANADA.

ONTARIO AGRICULTURAL COLLEGE EXPERIMENT STATION:
Bulletin No. 90, August 21, 1893.—Experiments with Winter Wheat.
BUREAU OF INDUSTRIES, TORONTO, ONTARIO:
Annual Report, 1890.
Annual Report, 1891.
Bulletin No. 46, July 11, 1893.—Crops in Ontario.
Bulletin No. 47, August 12, 1893.—Crops and Live Stock in Ontario.

PUBLICATIONS OF THE OFFICE OF EXPERIMENT STATIONS.

The Office of Experiment Stations issues three classes of publications for general distribution:

(1) Experiment Station Record, and (2) Bulletins, and Miscellaneous Bulletins, which are more or less technical. It is the practice to send to persons applying for them one or more numbers, from which they may judge of their usefulness, but not to place any names upon the mailing list until after receipt of applications on special blanks furnished by the Office.

(3) Farmers' Bulletins, which are brief and popular in character, and are sent on application. These bulletins are issued as part of the general series of Farmers' Bulletins of the Department of Agriculture.

The following publications have been issued:

Experiment Station Record, vol. I, 6 numbers; vol. II, 12 numbers; vol. III, 12 numbers and index; vol. IV, 12 numbers, including index; vol. V, No. 1. Copies of the station and Department publications abstracted in the Record can, in many instances, be obtained on application.

Bulletins.—No. 1, Organization and History of the Stations; No. 2, Digest of Annual Reports of the Stations for 1888, in two parts; No. 3, Report of Meeting of Horticulturists at Columbus, Ohio, June, 1889; No. 4, List of Station Horticulturists and Outline of their Work; No. 5, Organization Lists of Stations and Colleges, March, 1890; No. 6, List of Station Botanists and Outline of their Work; No. 7, Proceedings of the Fifth Annual Convention of the Association of American Agricultural Colleges and Experiment Stations, Washington, D. C., August, 1891; No. 8, Lectures on Investigations at Rothamsted Experimental Station; No. 9, The Fermentations of Milk; No. 10, Meteorological Work for Agricultural Institutions; No. 11, A Compilation of Analyses of American Feeding Stuffs; No. 12, Organization Lists of the Agricultural Experiment Stations and Agricultural Schools and Colleges in the United States, June, 1892; No. 13, Organization Lists of the Agricultural Experiment Stations and Agricultural Schools and Colleges in the United States, April, 1893; No. 14, Proceedings of a Convention of the National League for Good Roads, January, 1893: No. 15, Handbook of Experiment Station Work; No. 16, Proceedings of the Sixth Annual Convention of the Association of American Agricultural Colleges and Experiment Stations, New Orleans, Louisiana, November, 1892; No. 17, Suggestions for the Establishment of Food Laboratories.

Miscellaneous Bulletins.—No. 1, Proceedings of Knoxville Convention of Association of Agricultural Colleges and Stations, January, 1889; No. 2, Proceedings of Washington Convention of the Association, November, 1889; No. 3, Proceedings of Champaign Convention of the Association, November, 1890.

Farmers' Bulletins.—No. 1, The What and Why of Agricultural Experiment Stations; No. 2, Illustrations of the Work of the Stations; No. 9, Milk Fermentations and their Relation to Dairying; No. 11, The Rape Plant.

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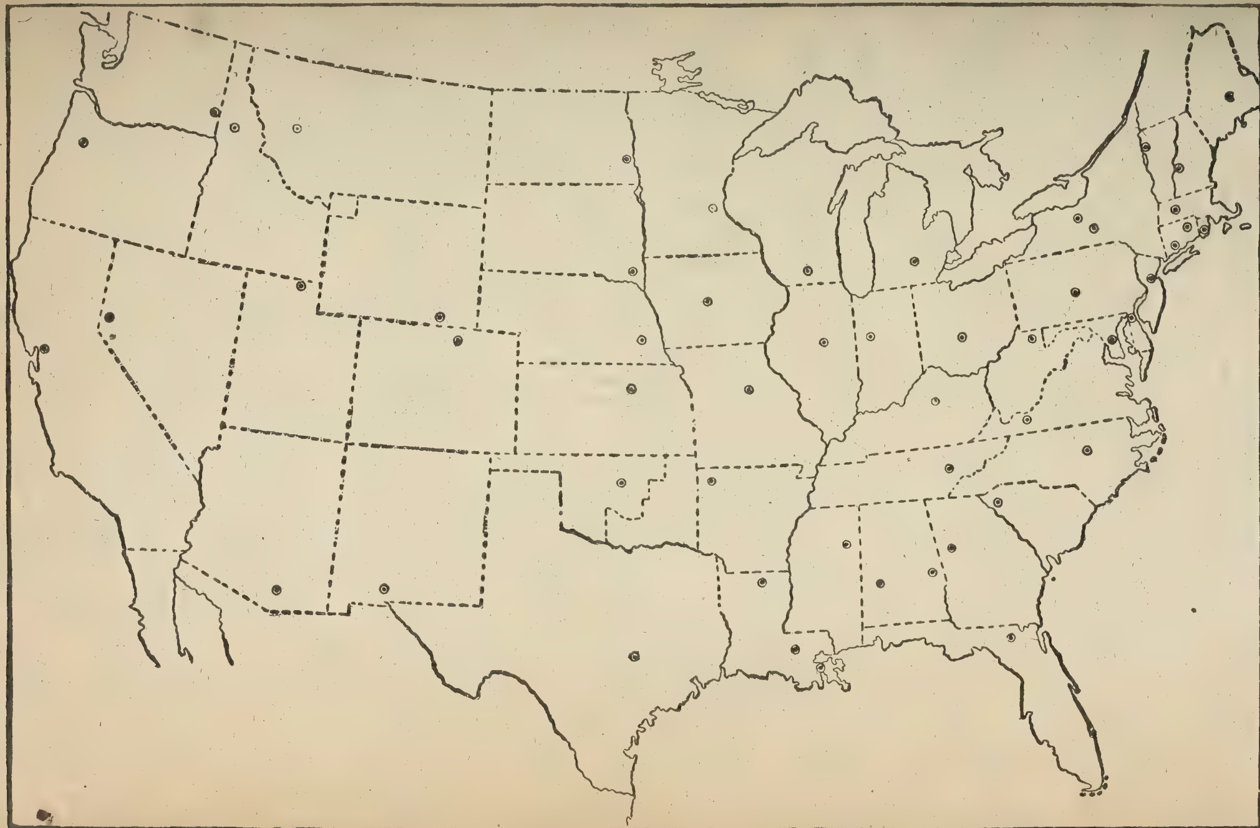

The Agricultural Experiment Stations in the United States.

R. Kent Beattie

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U. S. DEPARTMENT OF AGRICULTURE

OFFICE OF EXPERIMENT STATIONS

Vol. V No. 3

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WASHINGTON
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1893

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U. S. DEPARTMENT OF AGRICULTURE

OFFICE OF EXPERIMENT STATIONS

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EXPERIMENT STATION RECORD.

VOL. V. NO. 3

The convention of the Association of American Agricultural Colleges and Experiment Stations at Chicago, a brief account of which is given on page 272, while not so numerously attended as some other meetings of this body, was characterized by great earnestness and harmony of purpose, if not always of ideas. In spite of many outside attractions, the business sessions were well attended and a number of matters of importance were carefully considered. There was a commendable disposition to give serious heed to reasonable criticisms on the work of the stations, and the conduct of station officers. A notable indication of the temper of the convention may be found in the strong support afforded Director Thorne in his effort to impress upon station workers their obligation to give the stations due credit for all scientific work done under their auspices. Undoubtedly there have been cases in which investigators at our stations have forgotten that they are officers deriving at least a share of their support from public funds, and that while they should be given large liberty in their work, they must after all evince their loyalty to the cause of agricultural science by a prompt and frank acknowledgment of the institutions and the system which make their work possible. There must always be a certain difference between the conduct of institutions endowed by private persons and that of those maintained by the public. In the latter, the individual must yield something in order that the organization may be strengthened in public confidence. Somewhat more of regularity and formality must necessarily pertain to the intercourse of stations and station officers. In a word, in carrying on this work and in communicating the results the station worker should never forget that he is a public servant.

The agricultural congresses held at Chicago October 16–21 were well attended. While they had some popular features of transient value, many important papers were presented by eminent American and foreign workers in agricultural science. It is hoped that means will be provided for the publication of the proceedings of these congresses. Besides general sessions, meetings were held in the sections on fish and fisheries, forestry, veterinary surgery, good roads, household economies, agricultural education and experimentation, farm life and mental

culture, and ornithology. These congresses were under the general management of C. C. Bonney, president of the World's Congress Auxiliary, and S. W. Allerton, general chairman of the agricultural congresses. The Secretary of Agriculture was honorary president, and delivered an address at one of the general sessions.

A very high compliment was paid the experiment stations in assigning to station workers duties of vital importance in the conduct of the great test of dairy cows at the World's Columbian Exposition. The number of animals, the length of the test, the careful attention to every detail in the management of the animals, and the accurate recording of results, make this by far the most thorough experiment of its kind ever undertaken. The cost of the test, amounting to over $120,000, gives some indication of the greatness of the enterprise. An examination of the hundreds of pages of daily records of data collected during the trial reveals at once the complexity of the problems which the committee had to solve, and their patience and perseverance in carrying out their plan throughout a long season. That all this should have been done without a suspicion of unfairness or of neglect is indeed a wonderful testimony to the faithfulness of the men in charge. When the final reports are compiled we shall expect an array of facts which will not only teach many important practical lessons, but which will also suggest numerous questions deserving further examination and experiment.

The importance of the study of the physiology of plants is generally acknowledged by botanists, but various reasons have combined to prevent such systematic and exhaustive researches as are necessary to give us an adequate knowledge of the laws of vegetable life. It is surprising on how slender a basis of experimental inquiry many important deductions regarding the methods of plant development really rest. The detached and fragmentary character of many investigations leaves us in doubt whether we are justified in putting this and that together and saying that it will be thus and so in general for any class of plants. One fact has been brought out, it may be, with a plant of a high order and another with a plant of a low order. But the relation these facts bear to each other, and especially the modifying influences of the peculiarities of structure and development in individual species, may never have been worked out. Yet we are apt to go on making generalizations about plant life, and accepting as authoritative the somewhat dogmatic statements of manuals on vegetable physiology.

When we inquire, for example, how the wheat plant lives, we are perhaps told what is true of the development of the sunflower. In many particulars this may be all right, but after all it is the peculiar features of the life of the wheat plant which it may be most important for us to know. The systematic investigation of the physiology of particular species of plants throughout their life history is greatly

needed. The practical, as well as the scientific, importance of such researches in the case of cultivated plants is very great. Much attention is given to studies of the chemistry and physics of the soil and of fertilizers; meteorological conditions as affecting plant growth are observed; various methods of culture are tried; the diseases affecting the plant are investigated; but as regards the normal plant itself little has been done except to find out its chemical composition at different stages of growth and to make a few notes on the external appearance of its parts.

It is true that physiological inquiries, whether on plants or animals, are difficult to carry on. They often require complicated and expensive apparatus. The investigator must not only be thoroughly acquainted with what has been done in this line, but he must also be fertile in expedients for getting at the information he is seeking. However, these things which are hard to find out are the very ones our institutions for experimental research should seek after. There are some lines in which the stations are now working which it is useless to pursue further, unless we can get new facts with which to reconstruct methods of inquiry. The repetition of experiments after a certain time may only increase the mass of data for which we have no explanation. A better way would be to abandon the old beaten paths and try a new way which may lead to important and satisfactory results. In the department of botany in the stations, physiological questions should receive far more attention than at present. This is the line of botanical work which is most appropriate to our stations, because of its intimate relations to other experimental inquiries. Wherever opportunity offers laboratories should be equipped and trained workers employed for investigations on the physiology of cultivated plants. Routine work in botany in the old lines will amount to very little. Physiological studies may produce very important and far-reaching results.

SEVENTH ANNUAL CONVENTION OF THE ASSOCIATION OF AMERICAN AGRICULTURAL COLLEGES AND EXPERIMENT STATIONS.

The Association of American Agricultural Colleges and Experiment Stations held its seventh annual convention October 17–19, 1893, at Chicago, Illinois, in the Art Institute. Arrangements had been made to hold this convention in connection with the agricultural congresses under the auspices of the Congress Auxiliary of the World's Columbian Exposition. In view of the fact that papers on many topics by eminent American and foreign workers in the cause of agricultural science and education had been prepared for the congresses, it was thought advisable for the association to hold several joint sessions with the Congress on Agricultural Education and Experiment, and to confine the separate sessions very largely to matters of business.

The meetings of the Association were presided over by President Henry, while at the joint meetings of the Association and Congress Prof. Morrow, chairman of the Congress, presided.

One of the most interesting features of the convention was an address by Sir Henry Gilbert of the Rothamsted Experimental Station, being an introduction to six lectures on the agricultural investigations conducted for a period of fifty years at Rothamsted, to be delivered by Sir Henry in this country under the provisions of the Lawes Agricultural Trust. He described the methods of experimentation pursued at Rothamsted, the following excerpt showing the general plan:

> The general scope and plan of the field experiments has been to grow some of the most important crops of rotation, each separately, year after year, for many years in succession on the same land without manure, with farm-yard manure, and with a great variety of chemical manures, the same description of manure being as a rule applied year after year on the same plat. Besides the experiments on the growth of individual crops year after year on the same land, without and with different manures, so to speak, complementary experiments on the growth of crops in an actual course of rotation, without and with different manures, have been made, as also have others on the mixed herbage of permanent grass land, both without and with various manures. And here it is to be observed that the arrangement of the manures is made entirely regardless of the comparative cost as between plat and plat, the question at issue being entirely one of constituents against constituents, and not of shillings against shillings or dollars against dollars.
>
> It is obvious that the results of field experiments with the individual crops of rotation, conducted as above described, must of themselves throw much light on the characteristics of the particular crop under investigation, whilst those on the growth of crops in an actual course of rotation will serve to confirm and control those obtained with the individual crops, and will in their turn receive elucidation

from the results with the individual crops. Then again, the results of the experiments on the application of different manures to the mixed herbage of permanent grass land, which includes members of the botanical families that contribute some of the most important of our rotation crops, may, independently of their special value in reference to the main objects for which they were undertaken, be expected to afford interesting collateral evidence in regard to the requirements of individual plants thus grown in association, instead of alone year after year, or in rotation, as in the other series of experiments. Obviously, too, the chemical and, in some cases, the botanical statistics of the various crops so variously grown, and the chemical statistics of the soils upon which they have been grown, must afford very important data for further study and elucidation.

He emphasized the desirability of keeping entirely separate the work of investigation and the work of teaching, citing the fact that it had always been the policy of Sir John Lawes to refuse to take pupils at Rothamsted, and that he had made a provision in the endowment of the station that the funds should be used for purposes of investigation only.

The annual address of the president of the Association was delivered by Director W. A. Henry, of the Wisconsin Experiment Station. He gave a brief account of the organization of the experiment stations in this country and pointed out some of the merits and defects of their work. As illustrations of the benefit of the stations to agriculture, he cited their work on fertilizers, corn, sugar cane, forage plants, feeding stuffs, and dairying. He also urged the importance of the educational work which the stations have been doing among the farmers.

One reason that every earnest, faithful working experiment station has a strong hold on the agricultural people is because its workers have met the farmers at the institutes and farmers' club meetings for frequent conference, and have given instruction through the agricultural papers, acting in no small degree as teachers and counsellors. It is true, that when a station worker is on the institute platform or addressing a farmers' club, he is not investigating, and when he is writing for the agricultural press he is not doing laboratory work, but the call for help from our farmers has been so great, and so marked their appreciation, that it has been impossible to escape it. With earnestness on both sides and a desire to give and receive help, the most cordial and close relations now exist in a number of our States between the experiment stations and the intelligent farming people. To be frank with you, I believe that our station workers have in many cases accomplished more good for the cause of advanced agriculture through their efforts at instruction than through all they may have discovered.

Careless planning and lack of continuity were stated to be among the most serious defects of experiment station work. "One reason for the lack of continuity is the numerous changes in the personnel of our stations." Another reason was said to be the attempt to carry on too many lines of work.

In endeavoring to strengthen our work we must allow a large sum for maintenance and equipment after providing for salaries. In looking over the reports of some of our stations I am surprised at the small amount of funds left after the salaries are paid. I do not see how the workers in such stations can be content, for surely they can not always have the proper apparatus to work with. Another fault has been the lack of coöperation. We have talked about it in our annual gather-

ings, but have made little progress. I still feel that, though we have accomplished little, we should continue to look forward to a more general and hearty coöperation among those stations pursuing kindred lines of investigation.

He also urged that there should be a clearer demarcation between the duties of teacher and investigator in our colleges and stations. The plan of leaving the conduct of investigations very largely to assistants was condemned.

If we are to secure the highest results from our station work, our investigators must be put just as close to their subject-matter as is possible, and they must stay there from first to last. The investigator who is experimenting with steers or swine must keep close to his animals every day of the trial, not as a mere looker-on, but as a most careful observer and recorder of every action and every development. He who has growing plants under his charge must stay close with them from the time the seed is put into the ground until the harvest is over and the analyses completed. The teacher who spends his time in the class room or at his desk and turns over the care of his animals or his growing crops to subordinates is sure to lose that living connection which must hold between the worker and the objects investigated if there is to be any real scientific advancement. You might equally well have come to this great Columbian Exposition by proxy. You could have readily secured a young man for a dollar or two a day and expenses who would have come here and tramped through these buildings faithfully week after week and sent to you a carefully written record of his observations. But you would not have seen the Fair, nor can any man who wishes to get down to the marrow of an experiment do so by any other means than by giving himself up to that experiment, soul and body, from start to finish. But it will be said in extenuation of the system that our teachers are brainy men and have lots of work in them. So they have, but they are generally worked down pretty well in the class room. There was once a blacksmith in this country who, while pounding iron, by great industry and persistency, became master of fifty languages. He was called the learned blacksmith. There has been but one learned blacksmith in America, while each day at evening thousands of blacksmiths who have pounded iron all day go home to their families with tired muscles, in no fit condition for a tussle with roots and conjugations. Here and there may be a professor who can pound iron in the class room all day and write learned books or conduct deep investigations during his spare hours, but they are about as rare as learned blacksmiths. * * * But I would use our investigators for teachers, bringing the students to them for final polish, for rounding out the subjects under consideration, after each has had thorough drill under the best assistants the means would provide. The investigators being the strongest men in the institution, were we to bring a class to them one hour a day for one term in the year, they would impart instruction of the highest possible grade. And the student brought in contact with such men in the closing days of his college life will receive an impulse and gain a grasp of agriculture in its scientific phases that is impossible to impart to him in any other way. Drilling a student day after day in the elements he must master in order to attain the higher lines of the study requires one kind of teacher; to inspire him to a broad comprehension and a worthy grasp of the subject calls for another kind of teacher, and that teacher above all others is he who comes to the class room fresh from his field of investigation, with mind loaded down with the information he has been acquiring, and full of enthusiasm for his chosen subject. Under this system we can secure the highest sort of investigation in our stations, while the young men as they leave the college will carry an inspiration and an ideal with them that can be gained in no other way.

Director Thorne, of the Ohio Station, read a paper in which he urged the importance of the attendance of station workers at the annual con-

ventions of the Association. In his opinion, the methods and results of current scientific work at the stations should be set forth in papers which should form a part of the proceedings of the Association. He deemed it very important that due credit should be given the stations for all the scientific work done under their auspices, and to test the sense of the Association he offered the following resolution, which, after full discussion, was unanimously adopted:

Resolved, That it is the sense of this convention that all scientific workers, who are supported wholly or chiefly from funds appropriated by the National Congress for the encouragement of scientific instruction and investigation in agriculture, under the acts known as the Morrill and Hatch acts, should look upon it as a duty to so use the results of their investigations that due credit may unmistakably accrue to the American agricultural experiment stations, separately or collectively.

In the report of the section on college work President Dabney, of the University of Tennessee, presented a paper on military instruction in agricultural colleges, in which was strongly urged the necessity of additional appropriation by Congress to enable the War Department to provide camp equipage, band instruments, flags, uniforms for cadets, and other necessary material in order to successfully carry out the requirements of the acts of Congress which make military instruction compulsory. The recent report of the Inspector-General of the Army to the Secretary of War contains recommendations to be submitted to Congress which would authorize the War Department to sell to agricultural colleges such necessary equipment.

The committee on numbering publications, through its chairman, President Harris, of the Maine State College, submitted a report containing the following recommendations, which were adopted:

The convention of the Association of American Agricultural Colleges and Experiment Stations held at New Orleans, November, 1892, after a discussion of the inconveniences arising from the different methods of naming and designating bulletins in use by the experiment stations, appointed the undersigned as a committee to devise some uniform plan to be recommended to the stations. After due deliberation and consultation, we have the honor to present the following recommendations:

The publications of the experiment stations should consist of annual reports, bulletins, and circulars.

Annual reports should be numbered in regular order and be designated by the year which they cover, as "First Annual Report, 1888," "Second Annual Report, 1889." The annual reports should be printed as separate publications, and should not be called bulletins or numbered as such.

All bulletins, with the possible exception of meteorological bulletins, should be included in one series and bear the natural numbers in regular order, preferably without volume or year numbers, but in connection with these if necessary. They should always bear the date of publication on the title-page. This recommendation involves the abandonment of the use of letters or other peculiar means to designate "special" bulletins or those which are not to be distributed to the whole mailing list. In case bulletins are issued for limited circulation, a note should be included in the next bulletin for general distribution, stating the character of the omitted bulletin, and explaining why it was not sent to the whole mailing list. The words "new series," "second series," etc., should be omitted from the title-page of bulletins. They are not necessary since the number of a bulletin with the date of issue will always be sufficient for identification.

Reports of meteorological data, issued very frequently, may constitute a separate series of bulletins if desired, but the existence of this series should be explained in other bulletins by a note.

It will add to th· convenience of those who use the reports and bulletins if the stations will use page headings, printing on the left pages the name of the station ("Illinois Experiment Station"), or the designation and year of the publication ("Second Annual Report, 1890; Bulletin 27, 1891"), or both ("Connecticut Experiment Station, Second Annual Report, 1890"); and on the right pages the subject treated ("Spraying of Fruit Trees," "Fermentation of Tobacco").

Circulars should be used for inquiries or the publication of matter not requiring permanent record, and should never be made the sole repositories of matter of scientific or permanent value.

Newspaper bulletins should never be made the sole repositories of any information of permanent value.

The committee would call especial attention to remarks by Prof. S. W. Johnson on the preparation of bulletins and reports, which will appear in the proceedings of the New Orleans convention, and to the following resolution adopted at the Knoxville convention:

"(*a*) The bulletins to be uniform in size, 5¾ by 9 inches, and not to deviate from this measurement more than one quarter of an inch when trimmed. (*b*) The title-page to bear conspicuously the number of the bulletin, its date, the name, and post-office address of the station, the subject presented, and very little besides. (*c*) The reverse of the title-page (or page 2) to carry upon it all other information desired to be conveyed by the bulletin, except its principal subject-matter. (*d*) The annual report to be of the same size as the bulletins if practicable."

Respectfully submitted.

A. W. HARRIS.
W. A. HENRY.
A. A. JOHNSON.
S. W. JOHNSON.
R. J. REDDING.

HENRY E. ALVORD,
Chairman Executive Committee.

The report of the executive committee was presented by its chairman, H. E. Alvord, in which the attention of members was called to the advantage of sending as delegates to conventions members of the governing boards, in order that they may become actively interested in the work.

An offer was submitted from Powers, the sculptor, to prepare a marble bust of Hon. J. S. Morrill from a cast taken about the time of the passage of the act of 1862, and to make plaster casts for the agricultural colleges at a cost of $25 each, the marble bust to be placed at some place in Washington, to be subsequently designated.

H. P. Armsby, chairman of the committee on the coöperative experiment station exhibit, offered a short report, with the permission of the Association to submit to the new executive committee a full and complete report for publication in the proceedings of the convention. A similar report on the college exhibit will be made by H. E. Alvord.

Mr. J. W. Holcombe, of the Department of the Interior, called attention to the fact that the provision of the act of Congress of 1890, that a report from the president and treasurer of a college be submitted to the Commissioner of Education by September 1 was manda-

tory, and that while heretofore the Commissioner had recommended the payment of instalments on receipt of the treasurer's report, it was very desirable that the report of the president should be received by the Department not later than September 1.

Resolutions were adopted expressing the high appreciation in which the Association held the exhibits of the French agricultural colleges and experiment stations and of the Rothamsted Experimental Station.

A vote of thanks was given to Hon. W. I. Buchanan, chief of the Department of Agriculture of the World's Columbian Exposition, for his generous treatment of representatives of the Association in the assignment of space for the college and station exhibit, and for many other courtesies extended by him during the Exposition.

Papers were presented in the section on mechanic arts by Prof. C. W. Hall, of Minnesota, on Some relations of mechanic arts to agriculture, and by Prof. G. W. Bissell, of Iowa, on Shop work at the Iowa Agricultural College.

The following officers were elected for the ensuing year: President, S. D. Lee, of Mississippi; vice-presidents, G. E. Morrow, of Illinois; J. S. Newman, of South Carolina; H. Hadley, of New Mexico; J. H. Canfield, of Nebraska; and William Frear, of Pennsylvania; secretary and treasurer, M. A. Scovell, of Kentucky; executive committee, H. E. Alvord, of the U. S. Department of Agriculture; H. H. Goodell, of Massachusetts; H. C. White, of Georgia; and A. W. Harris, of Maine; bibliographer, S. W. Johnson, of Connecticut.

Section on college work.—Chairman, G. T. Fairchild, of Kansas; vice-chairman, A. W. Harris, of Maine; secretary, H. E. Stockbridge, of North Dakota.

Section on agriculture and chemistry.—Chairman, W. A. Henry, of Wisconsin; vice-chairman, W. P. Brooks, of Massachusetts; secretary, E. B. Voorhees, of New Jersey.

Section on horticulture and botany.—Chairman, E. S. Goff, of Wisconsin; vice-chairman, L. R. Taft, of Michigan; secretary, L. H. Pammel, of Iowa.

Section on mechanic arts.—Chairman, J. H. Washburn, of Rhode Island; secretary, F. P. Anderson, of Kentucky.

Section on entomology.—Chairman, H. Osborn, of Iowa; secretary, C. M. Weed, of New Hampshire.

ABSTRACTS OF PUBLICATIONS OF THE AGRICULTURAL EXPERIMENT STATIONS IN THE UNITED STATES.

CHEMISTRY.

E. W. ALLEN, *Editor.*

The effect of washing the magnesium-ammonium-phosphate precipitate upon the per cent of phosporic acid, B. W. KILGORE (*North Carolina Sta. Bul. No. 91d, July 6, 1893, pp. 8, 9*).—The results obtained in experiments in which the precipitates from acid phosphate and mixed fertilizers containing about 14 and 10 per cent, respectively, of phosphoric acid were washed different numbers of times, show discrepancies of 0.29 to 0.98 per cent between the phosphoric acid obtained with the highest and lowest number of washings.

These results "do not show the full magnitude of the differences that may and do, we think, occur from incomplete washing when the P_2O_5 reaches 20 per cent or more. We have, in fact, had differences greater than the ones here presented to occur, and on phosphates no higher in phosphoric acid than the ones on which these results were obtained. Differences of 0.20 per cent to 0.50 per cent may easily occur in some precipitates between 10 or 12 and 15 or 18 washings."

Hydrogen generator, hydrogen bath, and insoluble phosphoric acid bath, B. W. KILGORE (*North Carolina Sta. Bul. No. 91d, July 6, 1893, pp. 10–13, figs. 2*).—The apparatus used in the station laboratory for generating and purifying hydrogen gas, for drying either in an atmosphere or current of hydrogen, and for the digestion of fertilizing materials in ammonium-citrate solution are illustrated and described.

The hydrogen generator consists of a large bottle containing hydrochloric acid of 1.11 specific gravity, raised 5½ feet above a Kipp bottle filled above the contraction with either lump or granulated zinc. A ⅜-inch siphon tube connects the two bottles, reaching to the bottom of each. The flow of acid is started by blowing into the upper bottle. The gas is purified by passing through bottles containing sodium hydrate, sulphuric acid, and anhydrous copper sulphate. When the operation is ended the outlet tube of the generator is closed and the pressure of the gas forces the acid back into the reservoir. The spent acid can be drawn off from either the upper or lower bottle.

The water bath for drying in hydrogen is circular, double walled, 12 inches deep and 12 inches in diameter, with false bottom, inlet tube for hydrogen, which extends about 3 inches in the interior of the bath, exit tube in top, which extends nearly to the bottom of the bath, an opening for thermometer, and a condenser tube.

The bath is made air-tight by a projection on the top dipping into a groove filled with mercury or paraffin, made by soldering a piece of copper around the inside of the bath at the top. When mercury is used the groove must be coated with plaster of Paris, as also the projection where it is soldered on to the top.

The top is weighted, and the hydrogen passing in through the inlet tube fills the bath, beginning at the top and driving the air before it, after which there is a steady flow of hydrogen through the bath. The bath was intended to dry in an atmosphere of hydrogen, but it is large enough to put small pieces of apparatus on the false bottom and connect them with the inlet tube, and thus dry in a current of hydrogen as well.

The interior of a bath of this size, and even much smaller, can not be raised to the temperature of 100° C. by boiling water. We use a mixture of glycerol and water of such specific gravity as to give 100° C. The proportions of glycerol and water will depend on the size of the bath, and will have to be determined by experiment in each case.

The insoluble phosphoric acid bath is of galvanized iron, and sufficiently large to carry twelve flasks, which are held in an upright position by means of spring clamps at the top, and by fitting into the spaces of removed sections of the same size as the flasks of a skeleton disk near the bottom of the bath.

The framework holding the flasks is fastened to the shaft of an ordinary fly fan, by which the framework and flasks are revolved, thus agitating the water and keeping it at the same temperature in all parts of the bath, and making it easy to maintain a constant temperature in the bath as a whole. * * * This bath has been in use in this laboratory with good results for five years.

BOTANY.

WALTER H. EVANS, *Editor.*

Ohio Erysipheæ, A. D. SELBY (*Ohio Sta. Bul. vol. I, No. 3, tech. ser., Apr., 1893, pp. 213–224, fig. 1*).—A partial bibliography and the life history of the *Erysipheæ* are given, together with a key to the genera and a list of species known to be found within the State. The host plant is given, place and date of collection, and collector's name. Twenty-four species are enumerated, one of which, *Unicinula columbiana*, is described as new.

Additions to the list of Ohio Uredineæ, F. DETMERS (*Ohio Sta. Bul. vol. I, No. 3, tech. ser., Apr., 1893, pp. 171–180*).—Additions are made to the preliminary list of Ohio *Uredineæ* as published in Bulletin No. 44 of the Ohio Station (E. S. R., vol. IV, p. 414), as follows: Two species of *Uromyces*, 2 of *Melampsora*, 7 of *Puccinia*, 4 of *Gymnosporangium*, 1 of *Phragmidium*, 1 of *Coleosporium*, 1 of *Ravenelia*, 5 of *Æcidium*, and 2 of *Uredo*. Various species are reported upon other hosts than those previously given, additional localities are mentioned for the occurrence of some species, and a list of changes made in the nomenclature of the previous list. The arrangement is after that of Saccardo.

Analytical synopsis of the groups of fungi, W. A. KELLERMAN and A. D. SELBY (*Ohio Sta. Bul. vol. I, No. 3, tech. ser., Apr., 1893, pp. 206–213*).—The authors present an artificial key to the groups of fungi for the special benefit of beginners and amateurs. There is also a synopsis of groups, essentially a translation of Saccardo's Conspectus,

Distribution of and stations for rare and interesting Ohio plants, W. C. WERNER (*Ohio Sta. Bul. vol. I, No. 3, tech. ser., Apr., 1893, pp. 232–235*).—Notes on 17 species of rare and interesting plants.

New plants for the flora of Ohio, W. C. WERNER (*Ohio Sta. Bul. vol. I, No. 3, tech. ser., Apr., 1893, pp. 235–240*).—Report on 49 species not hitherto accredited to the flora of the State.

Notes on rare Ohio plants, A. D. SELBY (*Ohio Sta. Bul. vol. I, No. 3, tech. ser., Apr., 1893, p. 241*).—Notes on 3 species of rare plants.

Notes on new or rare plants of Ohio, W. A. KELLERMAN (*Ohio Sta. Bul. vol. I, No. 3, tech. ser., Apr., 1893, p. 241*).—Notes on the occurrence within the State of three rare plants.

Corrections and additions to Craig's catalogue of Phanerogams of Ohio University grounds, W. A. KELLERMAN and W. C. WERNER (*Ohio Sta. Bul. vol. I, No. 3, tech. ser., Apr., 1893, pp. 224–232*).—Corrections and additions are offered to Craig's catalogue, published as Bulletin vol. I, No. 2, technical series, of the station (E. S. R., vol. II, p. 253). Wrong and doubtful determinations to the number of 38 were given; 8 were cultivated species. About 70 additional species are mentioned by the authors as occurring within the range of the catalogue.

Bibliography of Ohio botany, W. A. KELLERMAN (*Ohio Sta. Bul. vol. I, No. 3, tech. ser., Apr., 1893, pp. 180–201*).—A chronological list of botanical papers referring to Ohio plants, from 1815 to the present time. Physiological and morphological, as well as many amateur papers, were excluded from the list. About one hundred and twenty-five papers are listed, some of which are briefly abstracted.

METEOROLOGY.

W. H. BEAL, *Editor.*

Report of the meteorological division of the Massachusetts Hatch Station, C. D. WARNER (*Massachusetts Hatch Sta. Report for 1892, pp. 158–164, charts 6*).—This report includes an account of additions to the equipment of the meteorological observatory; a review of observations on atmospheric pressure, temperature, and precipitation at Amherst for fifty-seven years (1836–'92); verifications of weather forecasts; and a brief discussion of the relation of climate to health.

The additions to equipment during the year include "a fine standard signal-service barometer for verifying the readings of the barograph, and Greeley's 'self-starting, self-stopping, ink-writing telegraph register.'" The latter is to be used in recording weather forecasts telegraphed to the college.

The principal features of the climate of Amherst, as shown by a review of meteorological observations for fifty-seven years, are given in the following summary:

Summary of meteorological observations at Amherst, Massachusetts, during fifty-seven years.

Mean barometric pressure, in inches, 1837–'92	29.741
Mean temperature, June, July, and August, 1836–'62	68.26° F.
Mean temperature, June, July, and August, 1862–'92	68.10° F.
Mean temperature, December, January, and February, 1836–'62	24.53° F.
Mean temperature, December, January, and February, 1862–'92	28.25° F.
Mean temperature, 1st period of nineteen years, 1835–'54	47.29° F.
Mean temperature, 2d period of nineteen years, 1854–'73	46.48° F.
Mean temperature, 3d period of nineteen years, 1873–'92	47.23° F.
Mean yearly temperature, 1836–'92	47.00° F.
Greatest annual rainfall, 1888	58.04 inches.
Least annual rainfall, 1837	30.70 inches.
Mean annual rainfall, 1836–'92	44.05 inches.
Amount of snow, 1840–'57, 923.7 inches; yearly average	54.33 inches.
Amount of snow, 1857–'74, 915.5 inches; yearly average	55.90 inches.
Amount of snow, 1874–'92, 889.9, inches; yearly average	49.44 inches.
Amount of snow, 1840–'92	230.42 feet.
Average per year	53.17 inches.
Greatest depth recorded, 1875	87.5 inches.
Least depth recorded, 1877	0.17 inches.
Mean cloudiness observed, 1845–'92	50.83 per ct.

A comparison of the daily forecasts from Washington, District of Columbia, and from Boston, Massachusetts, with the actual state of the weather at Amherst for each day during 1892, showed the following percentages of correctness: Boston forecasts, 90.6; Washington forecasts, 89.2.

From a partial review of the statistics bearing upon the relation of climate to health the following conclusions are drawn:

The curve of mortality has an inverse relation to temperature. In some climates, however, the curve of mortality and temperature are directly related, rising and falling together.

Fevers seem to be related to high temperature, and generally follow it.

The absolute humidity curve almost always follows that of cholera infantum and cholera morbus.

Pneumonia and diphtheria, smallpox, scarlet fever, and consumption invariably increase as the temperature falls.

"La Grippe" is thought to be the direct result of natural atmospheric conditions, chiefly a high followed by a sudden change to low temperature.

From careful observation it seems that there is a close connection between ozone at low temperature and deaths from pneumonia. The ozone and cholera curves are inverse to each other, as are also the ozone and intermittent-fever curves.

Report of the North Carolina State Weather Service for 1892, H. B. BATTLE, C. F. VON HERRMANN, and R. NUNN (*North Carolina Sta. Report of Meteorological Division for 1892, pp. 60, charts 3*).—The chief meteorological features of the year are shown in notes and tables compiled from the reports of 62 observers in North Carolina and the adjacent territory of Virginia, Tennessee, and South Carolina. The tables show (1) the annual summary for the year by months; (2) annual summaries of stations having complete or nearly complete

records during the year; (3) the highest, lowest, and mean barometer for each month of the year; (4) the maximum, minimum, and mean temperature for each month of the year; (5) the monthly precipitation and number of rainy days; (6) prevailing wind directions, and (7) comparisons of meteorological conditions for the past twelve years, 1881 to 1892, inclusive.

Miscellaneous data relating to snows, frosts, local storms, etc., which could not be placed in tabular form, are also given, together with lists of observers and stations in operation at the end of 1892, of weekly crop correspondents, and of stations receiving weather forecasts by telegraph or mail.

Meteorological summaries for North Carolina for May, June, July, and August, 1893, H. B. BATTLE, C. F. VON HERRMANN, and R. NUNN (*North Carolina Sta. Buls. Nos. 91c, June 20, 1893, pp. 21, charts 3; 91e, July 25, 1893, pp. 17, charts 2; 92a, Aug. 24, 1893, pp. 17, charts 2; and 92b, Sept. 20, 1893, pp. 19, charts 2*).—The usual summaries of observations by the State Weather Service, coöperating with the United States Weather Bureau, with a special article (Bul. No. 91*c*), on the Oxford tornado of May 3, 1893.

WATER—SOILS.

W. H. BEAL, *Editor.*

Geology of north Louisiana, O. LERCH (*Louisiana Stas. Special Report, part II, pp. 107, figs. 28*).

Synopsis.—This is the second report of progress in the geological and agricultural survey of the State, and includes extended accounts of observations on topography, geology, mineralogy, and soils of the region extending from the Vicksburg, Shreveport and Pacific Railroad on the north to a line passing east and west through Alexandria on the south, and from the Ouachita River on the east to Texas on the west, with minor notes on water supply, climatology, and flora.

Since the publication of part I of this report (E. S. R., vol. IV, p. 244) "the survey has been continued southward to a line drawn through the town of Alexandria in an easterly and westerly course, bounded by the Ouachita River in the east and the Texas State line in the west." For convenience the plan of the former report has been retained and an outline, with numerous illustrations, of the more prominent features of topography, drainage, and geology is given for this region, which is geologically and physiographically a continuation of that treated in part I.

The water supply of this district is discussed in some detail and analyses of 2 samples are given. "Where the red sandy clays form the surface formation, the subterranean waters are abundant and generally of excellent quality." In many cases, however, the wells are very shallow and the water is unfit for drinking purposes on account of the disease germs which it harbors, while the waters from some of

the deep wells are unhealthful on account of the large amounts of mineral matter, lime and magnesia salts, which they contain. Mineral waters whose medicinal qualities are highly prized are found in many localities.

The conditions for obtaining artesian water are exceedingly favorable and many wells have been successfully bored, flowing waters being found at comparatively shallow levels.

Beds of low-grade greensand and calcareous marls have been located. Analyses of 10 samples are given.

Gypsum "is found disseminated in small crystals, generally associated with the greensands. It is found in larger crystals and sometimes even in thin seams in the Jackson and Vicksburg beds, and also in large beds at Reyborn's Salt Works, and other cretaceous outcrops."

Other minerals which have been located and whose economic importance is discussed are limestone, building stones, gravels, iron ores, clays, kaolin, salt, and lignite. Analyses of 4 samples of lignite are tabulated.

A tabular statement of normal meteorological data for north Louisiana for each month of the year is given, together with a history of destructive overflows in the Red River Valley.

SOILS OF NORTH LOUISIANA (pp. 135-150).—*Soils of the red sandy clay region.*—These soils, occupying the hills of north Louisiana, may be classified into (1) black sandy, (2) gray sandy, (3) yellowish red sandy, and (4) deep red sandy loam.

These varieties graduate the one into the other almost imperceptibly. Yet in the central portion, from north to south, and in the Dolet hills, the red sandy loam predominates. * * *

The black sandy soils of this division, occurring particularly in the eastern and western portions of this district, owe their peculiarity of color to the presence of humus. They are derived mainly from the "drift," are underlaid by the red sandy clays, and vary in thickness from a few inches to many feet. They consist mainly of rounded quartz grains with small proportions of humus and mineral matters. They are poor, droughty, and easily washed away by heavy rains under improvident culture. * * *

The gray sandy soils possess in an intensified form the properties described under the black sandy soils, but are more deficient in humus. * * *

The yellowish red sandy soils occur in patches over the entire district, graduating on the one hand to gray sandy and on the other to sandy loams. They are superior in quality to either of the above and may be made very productive. They are mixtures of the "red sandy clays" and the "drift," and their physical properties are good, therefore they retain moisture fairly well and are not so subject to wash as those already described.

The red sandy loams, occupying chiefly the central portions of the district but occurring elsewhere in patches of varying size, are the characteristic "red lands" of north Louisiana. They are derived from the underlying "red sandy clays" wherever the overlying sands have been washed away. Magnificent fields of this class of soils are found in many portions of this part of Louisiana, and although long in cultivation are still yielding profitable crops. The color is due to iron oxide, and with this latter is usually associated a goodly percentage of phosphoric acid. This is an ideal soil, susceptible of the highest improvement and capable of producing enormous crops. With a similar subsoil, deep plowing, if gradually performed, will greatly enhance fertility and crop-producing power.

The crying want of all these soils, as demonstrated by the experiments at the

North Louisiana Experiment Station at Calhoun, is nitrogen. To supply this ingredient in its cheapest and best form recourse may be had to some of our running varieties of cowpeas. * * *

Bottom soils.—These have been derived wholly or in part from the underlying "Arcadia clays" (gray clays) described in the geological report as everywhere underlying the "red sandy clays." These soils are found in all the creek bottoms and wide flat valleys of north Louisiana and may be classified under two heads, (1) gray loams and (2) gray clays.

When the soils of the hills have been washed down and mixed with the gray clays of the valleys gray loams are to be found. Where no such washing has occurred the pure "gray clays" exist.

In small creek bottoms the former usually exist and are very productive. They are, however, subject to overflow, and therefore are usually not highly esteemed except for grasses and permanent pastures. Could they be properly drained and protected from floods they would be very valuable. * * *

These two classes of soils shade imperceptibly into each other, and in one bottom may be found every shade of soil from pure sand (washed down from the hills) to pure clay.

Soils of the prairie region.—These soils occur in insular spots along a broad band stretching across the State. These soils, like the formations from which they are wholly or partly derived, are calcareous and may be properly denominated as "marl soils." They may be classified as (1) marly clay soils or (2) marly loams—just in proportion as they have become mixed with the adjacent soils of the red sandy clays and drift—and like the other soils described they include soils of composition varying from one to the other. Yet they are all characterized by a goodly content of carbonate of lime. The marly clays are stiff, tenacious of water, drying and shrinking during hot weather, and difficult of cultivation. They are inky black in color, due to action of lime upon the vegetable matter, with a subsoil of similar composition but of lighter color. These soils usually lie well and are susceptible of easy drainage. * * *

The marly loams, of this same formation, contain also carbonate of lime and have a black color. They are underlaid by a similar subsoil of yellow marl, frequently in an almost unaltered condition. They are found surrounding the bare prairies and produce a vegetation peculiarly characteristic (described in the chapter on topography and botany). They are very fertile and well adapted to the production of large and various crops. * * *

All are subject to overflow, and are deep black in color, due to excessive moisture always present in the low places. * * *

Soils of the Grand Gulf region.—These are remarkable for their uniformity in texture and composition. Coming from the drift or soft sandstone of this formation they are mainly sands, varying in color from gray to black. They are frequently mixed with pebbles, and in appearance resemble the sandy soils of the red sandy clays. They are, however, of greater depth and therefore less fertile, having no retentive subsoil. Rarely a gray sandy loam is found in isolated patches in this formation, and while richer than the pure sands in soil ingredients are yet far from fertile. * * *

The bottom soils of this district rest upon the massive gray clays, intermediate strata of this formation, and are either pure clays or gray loams, just in proportion to their washings from the hills above. They possess the properties of the soils already described and need no further mention.

Diluvial soils.—These may be classed as (1) gray loam soil, (2) yellow loam soil, and (3) brown loam soil.

The gray loam constitutes the covering of the Red River flats, the yellow loam of those accompanying the Ouachita (Mississippi) River, and the brown loam forms the soils of the interior flats. This, however, is not quite correct, as sometimes either variety may be seen in patches intermingling with the other, and from the interior

flats it may be stated that the gray variety not unfrequently occupies extensive areas, though more or less intermingled with the brown loam. All these varieties consist of generally heavy loams only in spots. They assume a lighter texture, the sand causing it, especially in the gray variety, of exceeding fineness. On account of their composition, clay predominating, the varieties frequently shading into clay soils, as well as on account of their lay, occupying extensive level or slightly undulating flats, they are poorly drained, and during the rainy season of the year every depression, frequently very extensive, is converted into a pond or a shallow lake. A thorough drainage is needed to bring them under the head of tillable land. * * *

Hummock or second bottoms.—The soils of this peculiar topographic feature of north Louisiana are the most highly valued of all. Though of high fertility wherever met with, they differ so much in quality that only their general characteristics can be given in a preliminary report and it must be left to future detailed work to study and classify them. Occupying gentle slopes or narrow flats along the rivers and streams of this section, they vary in composition and physical properties with the geological formations which underlie them and which largely have furnished their material. On account of their favorable lay they are but seldom subject to overflow and are generally exceedingly well drained. They consist of wash derived from the adjoining hillsides and the underlying strata, with very frequently a large amount of humus from a vigorous vegetation which they support. They are therefore loose and easily tilled. Their content of nutritive elements is especially variable, but the physical properties they share to a large extent throughout the region. * * *

Alluvial soils.—The alluvial lands of the larger rivers traversing north Louisiana occupy such an immense area, and are of so great importance to the people of the State, that it will take more than a full season's work to study their geological and agricultural features enough to treat them with some justice, even in a preliminary report. One of the highest authorities on scientific agriculture in America, Dr. Eugene Hilgard, remarks of their soil: "Equaled by few and surpassed by none in the world in productive capacity." They occupy an area of about 6,000 square miles in north Louisiana and must form for this, as well as the former reason, the subject of another report.

Analyses of representative soils and subsoils (forty-five in all) of some of the above formations are tabulated and discussed.

[From these it is seen that] the soils and subsoils of the red sandy clays fall below the standard for lime, potash, and phosphoric acid and some are very low in nitrogen. * * *

The bottom soils are rich in potash and lime. It is unfortunate that neither the phosphoric acid nor nitrogen was determined. It is highly probable that the former exists in fair quantities.

The one prairie soil examined was rather low in phosphoric acid, but otherwise most excellent.

Drift soils are poor in every valuable ingredient.

While the general composition of diluvial soils is fair, they are low in phosphoric acid and will doubtless respond well to manures containing this ingredient. * * *

No comment is needed upon the alluvial soils further than to say that applications of nitrogen in an available form will enable them to grow the largest crop. All the other ingredients are present in sufficient quantities for present wants.

A list of the trees, shrubs, grasses, and medicinal plants of this region is given.

The danger from the deforestation of certain soil areas of north Louisiana is forcibly pointed out.

Whenever the protecting cover of forest is removed from [the loose sandy soils of the Grand Gulf formation] they will commence to float southward with each rain,

and many a fertile tract will be buried underneath them in the coming years. Winds will assist in their speedy transport. The climate of the country will be materially changed, and the droughty weeks now occasionally occurring will be protracted into months, and the floods during the rainy season will be by far more heavy and destructive.

Analyses of drinking water, J. L. HILLS (*Vermont Sta. Report for 1892, p. 32*).—Tabulated analyses of 13 samples of water, with reference to fitness for drinking purposes.

Analyses of fig soils, M. E. JAFFA and G. E. COLBY (*California Sta. Bul. No. 102, June, 1893, pp. 6–8*).—Analyses are given of 3 samples "of the soils from the Asia Minor districts whence comes the Smyrna fig of commerce," and, by way of comparison, of 9 typical soils from different regions of California where fig culture seems to succeed. The latter, with one exception, are taken from previous reports of the station.

The physical characteristics of the different soils are described, showing a considerable range in the quality of soils adapted to the growth of figs:

The comparison of the analyses of the Asia Minor soils with those from this State shows very strikingly the richness in phosphoric acid of the former over the latter. The lowest percentage of this ingredient in the Asia Minor soils (0.29) is more than one and one third times as much as the highest (0.22) of the California soils, and the average, 0.32 per cent of the three Smyrna soils, is almost exactly four times the average for all California soils examined (about 200 in number) and nearly three times the figure (0.113) denoting the average of phosphoric acid for 466 soils of the humid region (east of the Rocky Mountains) of the United States.

With reference to lime, the average for the Asia Minor soils is 2.60 as against 1.08 for California. The figures 0.690 for Asia Minor and 0.644 for California, representing the averages for potash, show that both sets of soils are about equally well supplied with this element of plant food.

A marked difference in favor of California soils is at once seen when the humus percentages are compared. The average for the Asia Minor soils is only 0.47, being less than one half that, 1.08 per cent, found for the average of 198 California soils.

Michigan soils, R. C. KEDZIE (*Michigan Sta. Bul. No. 99, July, 1893, pp. 15*).—Chemical analyses with comments are given for 38 typical soils classified, "rather for their agricultural uses than their chemical composition," as follows: Wheat lands, 9 samples; peach belt soils, 9 samples; soils of the potato district, 3 samples; soils of the jack-pine plains, 4 samples; soils for special crops—muck lands adapted to the growth of celery, cranberries, peppermint, etc., 3 samples; and soils for general purposes, 10 samples.

Analyses of Nevada soils, N. E. WILSON (*Nevada Sta. Bul. No. 19, Dec., 1892, pp. 29–35*).—The following table shows the composition of three Nevada soils examined with a view to determining their adaptability to the culture of sugar beets. No. 3 is from the station farm, and appears to be "particularly adapted to beet-raising, producing beets containing from 12 to 23.8 per cent of sucrose."

Analyses of Nevada soils.

	No. 1.	No. 2.	No. 3.
	Per cent.	*Per cent.*	*Per cent.*
Moisture	1.003	0.613	2.204
Insoluble silica	58.064	62.217	61.843
Hydrated silica	16.058	8.899	17.175
Soluble silica	0.147	0.064	0.076
Sesquioxide of iron (Fe_2O_3)	3.116	1.679	9.058
Alumina (Al_2O_3)	3.875	1.099	1.333
Phosphoric acid (P_2O_5)	0.125	0.040	0.019
Lime (CaO)	7.492	9.580	2.801
Magnesium (MgO)	3.031	2.332	0.574
Potash (K_2O)	0.364	0.016	0.128
Soda (Na_2O)	0.627	0.021	0.607
Sulphuric acid (SO_3)	0.075	0.016	0.060
Chlorine (Cl)	0.004	0.030	0.012
Carbonic acid (CO_2)	5.469	8.313	0.202
Volatile and organic matter	1.023	4.209	2.618
Total	100.473	99.129	98.710
Nitrogen (N)	0.086	0.078	0.056
Mechanical analysis—			
Stones	3.03	2.29	9.02
Coarse gravel	4.16	6.71	7.36
Fine gravel	7.84	10.93	27.00
Fine material	84.97	80.07	56.62
Total	100.00	100.00	100.00

For comparison analyses of four soils from the best beet-growing sections of France are quoted.

"With the exception of the alkali soils our soil is well adapted for beet-growing, and can be found in tracts amply large for the purpose on the line of the Central Pacific, Virginia and Truckee, and Carson and Colorado railroads."

FERTILIZERS.

W. H. Beal, *Editor.*

The effect of organic matter on natural phosphates, N. T. Lupton (*Alabama College Sta. Bul. No. 48, July, 1893, pp. 3–11*).—To test the comparative productiveness of ground raw phosphates and acid phosphate, either alone or in connection with decomposing organic matter, fine ground Florida phosphate containing 16.54 per cent of total and 0.32 per cent of available phosphoric acid, and acid phosphate containing 14.36 per cent of total and 12.04 per cent of available phosphoric acid, were each applied at rates of 400 and 800 pounds per acre, alone or in combination with cotton-seed meal in amounts of 400 and 800 pounds per acre, on seventh-acre plats of poor sandy soil, and with the same amounts of both cotton seed and cotton-seed meal on similar plats of strong red soil.

From the tabulated yields of seed cotton per acre on the different plats it appears that, although the results are irregular, especially on the plats of strong red soil, which were "not uniform in natural productiveness, * * * the pulverized raw phosphate evidently produced

as good or better results than the acid phosphate whether used alone or mixed with cotton seed and cotton-seed meal." This confirms results previously obtained in similar experiments reported in Bulletin No. 22 of the station (E. S. R., vol. II, p. 548). In laboratory experiments fine ground Florida phosphate and South Carolina floats, in amounts of 1 and 2 pounds, were each rubbed up in a mortar with one half pound of cotton-seed meal or cotton seed, moistened, transferred to wide-mouthed jars, and allowed to ferment, with frequent stirring. After fermentation had commenced samples were withdrawn at short intervals and analyzed. "The results seem to show that the fermentation of the cotton seed and cotton-seed meal had very little, if any, effect on the ground Florida phosphate or the South Carolina floats in converting the insoluble into soluble phosphate."

Analyses and study of home-mixed fertilizers and fertilizing materials, L. A. VOORHEES and J. P. STREET (*New Jersey Stas. Bul. No. 93, July, 1893, pp. 24*).—This bulletin is devoted to discussions of statistics relating to the consumption of fertilizers in New Jersey; the preparation of formulas; the mechanical condition, composition, and valuation of home mixtures; comparisons of methods of buying mixed fertilizers and raw materials; trade values of fertilizing ingredients for 1893; average cost per pound of plant food constituents; and chemical analyses of 10 home-mixed fertilizers and 102 samples of other fertilizing materials, including nitrate of soda, sulphate of ammonia, dried blood, dry ground fish, cotton-seed meal, ground bone, dissolved bone, tankage, nitrogenous and plain superphosphates, South Carolina rock and other mineral phosphates, muriate of potash, kainit, and sulphate of potash and magnesia.

The following practical conclusions are drawn from the work:

(1) The use of fertilizers in the State is increasing, and the present annual expenditure of over $1,500,000 may be very materially reduced by a definite knowledge of what and how to buy.

(2) In the preparation of formulas the quality of plant food is of prime importance, and the proportion of the different elements as well as the amount of the application should be determined by the object of their use.

(3) Farmers can make mixtures which are equal to the best manufactured brands and superior to the average—first, in mechanical condition; second, in concentration; third, in quality; and fourth, in point of cost.

(4) In buying manufacturers' mixtures distinct advantages in quality and cost are secured when bought direct from the manufacturers instead of from local agents.

The available phosphoric acid in crude fertilizing materials, B. W. KILGORE and R. E. NOBLE (*North Carolina Sta. Bul. No. 91d, July 6, 1893, pp. 3–7*).—The materials examined were fish scrap, tankage, azotin, dried blood, bone meal, and cotton-seed meal, and the objects of the investigation were (1) to estimate the available phosphoric acid, (2) to determine the effect of fineness upon the available phosphoric acid, and (3) to compare different methods of determining total, soluble, and insoluble phosphoric acid. The results are tabulated in full:

Available phosphoric acid.—Our average results show the available phosphoric acid to be, in fish scrap 3.08 per cent, tankage 5.17 per cent, beef azotin 2.54 per cent, pork azotin 1.00 per cent, dried blood 0.71 per cent, bone meal 6.01 per cent, and cotton-seed meal 2.65 per cent.

Fineness.—The factor of fineness appears to have had little or no influence on the amount of phosphoric acid dissolved by cold distilled water and "ammonium-citrate solution" (the available phosphoric acid), except in the case of bone meal, where there is an average difference of 0.51 per cent in favor of the samples put through the 40-mesh seive, which is, approximately, 40 meshes to the linear inch. The average results of all the others, except beef azotin, where they are the same, are slightly higher for the 40 than the 20-mesh seive, but the differences are rather too small to be taken into consideration. Cotton-seed meal was not put through the 40-mesh seive because of its low per cent of insoluble phosphoric acid, and it is not likely that it would be changed by such treatment.

Methods.—The total phosphoric acid in the results reported was determined (1) by dissolving the material in nitric acid and a little hydrochloric acid, and (2) by igniting with magnesium nitrate, dissolving the residue in hydrochloric acid and a little nitric acid, and following the present official method of the Association of Agricultural Chemists for phosphoric acid. * * *

Soluble phosphoric acid was determined (1) by direct precipitation of the water extract of the materials, and (2) by evaporating the water extract to dryness, igniting gently, dissolving the residue in hydrochloric acid and a little nitric acid, and proceeding as indicated above for total. * * *

Insoluble phosphoric acid was determined (1) by the regular official method of igniting both the "citrate-insoluble" residue and filter in a small platinum dish, dissolving the ash in hydrochloric acid and a little nitric acid, and (2) by treating the filter and citrate-insoluble residue directly in a 200 c. c. flask with nitric and hydrochloric acids. * * *

So far as methods are concerned the following conclusions are drawn from the results on the materials here examined:

(1) For total phosphoric acid, the nitric and hydrochloric acids and magnesium-nitrate methods are equally reliable for all materials, except cotton-seed meal, where the magnesium nitrate, incineration, or sulphuric acid and potassium-nitrate method, or some of its modifiations must be used.*

(2) For insoluble phosphoric acid, direct solution of the filter and citrate-insoluble residue in nitric and hydrochloric acids and official ignition methods are equally reliable for all the materials.

(3) For soluble phosphoric acid, the results by the "ignition" and "direct precipitation" methods compare fairly well in all the materials, except cotton-seed meal, where the ignition method is the only safe one.

The total and water-soluble potash in cotton-seed meal, B. W. KILGORE and R. E. NOBLE (*North Carolina Sta. Bul. No. 91d, July 6, 1893, p. 9*).—Analyses of 3 samples of cotton-seed meal gave the following average results: Total potash 1.73 per cent, soluble 1.48 per cent; showing that "85.5 per cent of the total potash in these samples of cotton-seed meal was soluble in water."

Fertilizer inspection and analyses in Alabama, N. T. LUPTON (*Alabama College Sta. Bul. No. 48, July, 1893, pp. 10–80*).—Abstracts from the State laws relating to fertilizers; a list of licenses granted up to August 1, 1893; a statement of the guaranties filed in the office of the Commissioner of Agriculture of the State by dealers and manufac-

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* See Bul. No. 8 of the South Carolina Station (E. S. R., vol. IV, pp. 901, 902).

turers, and tabulated analyses by J. T. Anderson of 343 samples of fertilizing materials examined since July 1, 1892, including bone meal, dissolved bone, tankage, dried blood, ashes, black-jack ashes, pine-cone ashes, muriate of potash, kainit, Florida, and other natural phosphates, marl, and commercial fertilizers.

Fertilizer inspection and analyses in Kentucky, M. A. SCOVELL and A. M. PETER (*Kentucky Sta. Bul. No. 46, Aug., 1893, pp. 22*).—General statements regarding the sources, nature, uses, and comparative value of fertilizing substances; text of the State fertilizer law; rules and regulations regarding the fertilizer control; advice to farmers regarding the purchase of fertilizers; directions for sampling; and tabulated analyses and valuations of 93 samples of fertilizing materials, including ground bone, dissolved bone, Odorless Phosphate, and mixed fertilizers.

Fertilizer inspection and analyses in Michigan, R. C. KEDZIE (*Michigan Sta. Bul. No. 97, July, 1893, pp. 15*).—A discussion of the object of inspection and analyses of fertilizers, text of the State fertilizer law, and tabulated analyses with guaranties of 57 samples of commercial fertilizers examined during 1893.

Fertilizer inspection and analyses in New York (*New York State Sta. Bul. No. 58, July, 1893, pp. 15*).—A schedule of trade values of fertilizing materials and foods, and tabulated analyses with guaranties of 54 samples of commercial fertilizers collected in Long Island in the spring of 1893.

Fertilizer analyses and inspection in North Carolina, H. B. BATTLE (*North Carolina Sta. Buls. Nos. 89a, Mar. 18, 1893, pp. 11; 90c, Apr. 19, 1893, pp. 15; 91b, June 19, 1893, pp. 15*).—Notes on valuation, a digest of the State fertilizer law, freight rates from the seaboard to interior points, and tabulated analyses with valuations and guaranties of 522 samples of commercial fertilizers.

Fertilizer inspection and analyses in Rhode Island, H. J. WHEELER and B. L. HARTWELL (*Rhode Island Sta. Buls. Nos. 23, July, 1893, pp. 18; and 24, Aug., 1893, pp. 7*).—Notes on valuation and on the purchase and home-mixing of fertilizers, with tabulated analyses of 89 samples of fertilizing materials, including bone, ashes, cotton waste, wool washings, dried blood, prepared leather waste, picker waste, dry ground fish, gypsum, and home-mixed and factory-mixed fertilizers.

In our work in connection with the fertilizer inspection in this State we have been strongly impressed with the following facts:

(1) There is a tendency among many of our farmers to buy a low-grade fertilizer because it is cheap, without regard to whether it is really good economy or not.

(2) In general the higher grades of fertilizers are really more economical than the lower ones.

(3) With but few exceptions the farmers of the State do not pay enough attention to the form of the nitrogen, phosphoric acid, and potash in their fertilizers. The tendency is to buy this or that fertilizer because it gave, at some time, remarkable results, regardless of all conditions of soil and climate.

(4) Our farmers are not sufficiently awake to the fact that large quantities of slow-acting organic nitrogen in form of leather, hair, horn, etc., find their way into some of the mixed fertilizers and that the chemist finds it difficult or impossible to detect them.

(5) Our farmers are beginning to see that it is more economical to buy their materials and mix their own fertilizers, and that thereby they may be sure of the quality of the material they are getting.

Fertilizer inspection and analyses in Vermont, J. L. HILLS (*Vermont Sta. Report for 1892, pp. 30, 31, 36–43*).—A summary is given of the results of fertilizer inspection in Vermont from 1885 to 1893, inclusive, which includes tabular statements, with comments, regarding the trade values of fertilizing ingredients in raw materials, the average analyses of standard brands and of all brands examined, comparisons of analyses and guaranties, and comparisons of average analyses of fertilizers examined in Vermont and Connecticut.

During these nine years, twenty-one firms have offered the Vermont farmer over 75 brands of fertilizers, and there have been 296 samples analyzed in the course of the regular inspection work. * * *

During this time the average selling prices have fallen from $37.90 to $32.32 per ton, there being some decrease each year. * * *

The percentage of increase of cost over valuation shows a marked decrease from 1885 to 1889, since which time it has increased again.

Analyses are given of 24 samples of fertilizing materials, including ashes, peat ashes, peat, muck, tankage, bone meal, Odorless Phosphate, and a mixed fertilizer.

FIELD CROPS.

J. F. DUGGAR, *Editor.*

Field crops, W. P. BROOKS (*Massachusetts Hatch Sta. Report for 1892, pp. 151–156*).—These experiments are mostly in continuation of those reported in Bulletin No. 18 of the station (E. S. R., vol. III, p. 866). The yields of 3 species of millet, of 3 varieties of soja beans, and of Japanese or Chinese radish are given. Hemp, flax, and white mustard were grown.

The influence of fertilizers upon the quality of potatoes was studied in connection with the soil tests reported in Bulletin No. 18. A large number of chemical analyses were made for this purpose. The leading indications afforded by the analyses are that (1) nitrate of soda and superphosphate are favorable to starch formation and good quality; (2) muriate of potash is distinctly unfavorable to starch formation; and (3) manure will produce tubers of better quality than a "complete fertilizer" in which the potash is in the form of the muriate.

In two experiments sulphate of potash gave a larger yield of potatoes than did muriate of potash; those from sulphate of potash were also better in quality.

Soil tests of corn, oats, potatoes, grass, and soja beans were conducted.

The results are not fully worked up, but the following are the leading points indicated: (1) Potash is the controlling element for beans and corn; (2) nitrate of soda is beneficial to oats; (3) nitrate of soda greatly increases the yield of grass;

and (4) muriate of potash causes a remarkable increase in the proportion of clover in mowings where timothy, red-top, and clover seeds are sown.

Six cords of manure per acre gave better results on corn than 3 cords of manure and 124 pounds of muriate of potash. Drill culture of corn gave a slightly larger yield than hill culture. A home-mixed fertilizer rich in potash gave a larger yield of millet (grain and straw) and of corn stover, but a smaller yield of corn, than did a special corn fertilizer.

The proper time for harvesting fodder corn, J. L. HILLS (*Vermont Sta. Report for 1892, pp. 157–162*).

Synopsis.—A study of the best time for cutting Sanford and Red-Cob corn for fodder or for silage showed that in the case of both varieties the largest amount of dry matter, protein, nitrogen-free-extract, and fat was secured by cutting when the kernels were beginning to glaze, or were slightly glazed.

Tests of the best time for harvesting King Philip and Burrill and Whitman corn were reported in the Annual Report of the station for 1889, (E. S. R., vol. II, p. 667). In the present case the trials were with Sanford and Red-Cob varieties. In the case of each variety, an area where the growth was even was selected in the midst of a large field, and the corn cut at five different dates between August 13 and November 27. The stages of growth represented were from before tasseling until after frost. Analyses are given of samples of each variety at each cutting, and a calculation is made of the yield of both food and fertilizing ingredients per acre. The largest amounts of dry matter and of protein, nitrogen-free extract, and fat were secured in case of both varieties from the cuttings made from September 13 to 28, when the kernels were in the early stages of glazing. The reports of similar trials at the New York Cornell, New York State, New Hampshire, Pennsylvania, and Vermont Stations are summarized, from which it appears that "green fodder usually weighs the most just as the kernel begins to glaze, but it does not then contain as much dry matter as when fully glazed and mature. Hence such varieties as will mature in Vermont latitudes should stand as long as they are safe from frost. The increase in dry matter after the kernel has begun to glaze is mainly nitrogen-free extract."

Some analyses of cowpeas and prairie grass, G. L. HOLTER (*Oklahoma Sta. Bul. No. 6, May, 1893, pp. 33–39*).—Analyses of Whippoorwill cowpea at five different stages, and of prairie grass, "composed almost wholly of blue-stem and joint grass," at three different cuttings.

[With reference to the cowpea,] our results would indicate that for a good hay the peas, including vines, leaves, and pods, should be harvested as soon as the peas have matured in the pods. Should the crop be late, it is better to cut before complete maturity than to delay the harvesting until a heavy frost has killed the vines and leaves.

An examination of the analysis [of prairie grass] shows the earlier cutting to be

much richer in protein and fat, also to contain more fat and fiber than Kentucky blue grass, but not as much carbohydrates.

Remarks are also made on feeding cotton-seed meal.

Test of varieties of grasses, A. C. MAGRUDER (*Oklahoma Sta. Bul. No. 6, May, 1893, pp. 27–32*).—Seventy-three varieties of grasses and forage plants were tested under very trying circumstances. Of this number 41 died, 23 came through the winter in poor condition, and 9 withstood heat, drought, freezing, and thawing in a very satisfactory manner. The experiments will be continued, as well as some being conducted on the improvement of some of the native species of grasses.

Progress report on grasses and other forage plants, J. C. NEAL (*Oklahoma Sta. Bul. No. 6, May, 1893, pp. 19–26*).—The author gives detailed reports on about 40 forage plants. They had been subjected to severe drought during the summer and to a hard winter. Some species give promise of value and will be investigated further. Cowpeas are advised both for forage and for the effect on the soil.

Sugar beets, R. H. MCDOWELL and N. E. WILSON (*Nevada Sta. Bul. No. 19, Dec., 1892, pp. 3–28, figs. 5*).—A continuation of the work reported in Bulletin No. 13 of the station (E. S. R., vol. III, p. 445) on growing sugar beets at the station and in different parts of the State. Seed was sent to farmers in every county in the State; 7 varieties or subvarieties were grown. The beets on the station farm were irrigated ten times, plowed five times, and hoed three times. Farmers, on an average, irrigated and plowed three times and hoed once.

Directions for growing beets and for taking samples for analysis are given; also notes on implements used in cultivation, and on the financial aspect of beet culture and beet-sugar manufacture.

Gophers destroyed some fields of beets in Nevada. Directions for their destruction are quoted from Bulletin No. 12 of the Wyoming Station (E. S. R., vol. IV, p. 802).

Analyses of 221 samples of beets are tabulated. The highest per cent of sucrose in the juice was 23.5; the maximum purity, 99.42.

A summary of the meteorological conditions during the growing season and analyses of three Nevada soils and of four soils from sugar-beet districts in France are given.

Ensiling sugar beets and straw, J. L. HILLS (*Vermont Sta. Report for 1892, pp. 162, 163*).—Sugar beets were ensiled with cut straw, the latter constituting, in four different cases, from one fifth to one twentieth of the whole mass. The material remained in the silo from three weeks to two months. The loss in weight in ensiling ranged from 3.5 to 9 per cent.

HORTICULTURE.

Third report on electro-horticulture, L. H. BAILEY (*New York Cornell Sta. Bul. No. 55, July, 1893, pp. 127–138*).

Synopsis.—An electric light with glass globe, hung above the greenhouse roof, exercised very little pronounced influence on cauliflowers. A naked electric arc lamp in the greenhouse greatly injured cauliflowers growing near it, but exerted little influence beyond 10 feet. Electric light transmitted through glass screens of different colors exerted decided influences on radish and lettuce plants early in their growth. These influences tended to disappear as the plants approached maturity, so that no important difference in the value of the crop resulted.

A report on work in continuation of that recorded in Bulletin No. 42 of the station (E. S. R., vol. IV, p. 349).

Effect of screened light on cauliflowers.—In the first experiment a 10-ampere 45-volt Westinghouse alternating current lamp of 2,000 nominal candle power was hung 9 feet above the greenhouse roof. Half of the globe of the lamp was of clear glass; the other half was painted a dense black, which, with the curtains dividing the greenhouse into two compartments, enabled one half of the house to be lighted while the other half was kept dark. Extra Early Dwarf Erfurt, Gilt Edge Snowball, and Early Snowball cauliflowers about 6 inches high were set in the bed October 4 and the electric light started October 11, giving an average of 4.8 hours of light per night for one hundred nights. November 1 the plants in the light compartment were fully 10 per cent larger than those in the dark room, and continued to gain over the others in height and general appearance, but began to head later. On December 9 there were 19 heads forming in the dark compartment and only 12 in the other. The average weight of plant, average diameter of head, and average length of longest leaf for each variety are tabulated.

These averages are conflicting. The two strains of Snowball gave much larger heads in the dark house, as shown by the average diameter of the heads. This corresponds with the results obtained a year ago. But the plants—or leaves—were also longer in the dark house, which is opposed to former results. * * * With Erfurt decidedly better results were obtained in the light house. The total average of the results shows that in size of head and length of leaves the light and dark houses gave about equal results. It was noticeable, however, that the plants under the light held their leaves more erect than the others. It is probable that, under the conditions of this experiment, the electric light exercises very little pronounced influence upon cauliflowers.

Effect of the naked electric light at different distances on cauliflowers.—In the second experiment the electric lamp, without a globe, was hung January 25, 1893, inside at the extreme end of the house, and about 3 feet above the soil in the cauliflower bed, with a large mirror behind the light. On the same day cauliflower plants about 6 inches high were set in the beds of a greenhouse 60 feet long. With five exceptions the light burned four to six hours per night until April 20.

The plants standing near the light were injured by it. By the middle of February the leaves on the plants within 4 or 5 feet of the lamp were much curled and crinkled. On March 1 this curling was apparent 10 feet from the lamp, and the plants were stunted and had a more strict or upright growth than those farther away. The same injury was noticed in lettuce plants which had been set between the cauliflowers, although it was less marked. The first heads to develop were noticed on Snowball plants March 21, near the end of the bed farthest from the light. The first heads were sold March 29, from near the dark end of the house. The harvest was continued until May 1.

A table is given showing the behavior of each variety with reference to proximity to the light, earliness, weight of plant, diameter of head, and length of the longest leaf.

While it is true that the very earliest heads were obtained from points far removed from the light, there does not appear to be any uniform behavior, so far as these measurements go, in reference to the light. Plants near the light were much injured and it is not until the fifth or sixth rows are reached, or a distance of 7 to 10 feet, that plants and heads of normal size are procured. It must be said, however, that the lamp hung so low that beyond 15 or 20 feet the plants were much shaded by their own leaves and by plants in front of them, and that the influence of the rays was therefore much broken. The general results, therefore, seem to indicate that the baneful influence of the naked electric arc lamp of this pattern is dissipated in cauliflowers at a distance of about 10 feet, and that beyond that point the light appears to exert little influence.

Effect of lights of different colors on radish and lettuce.—The third experiment was to determine the behavior of plants under electric lights of different colors.

A lamp like the one used for the other experiments was surrounded by a six-sided frame, the back of which was a bright tin reflector to throw the light strongly upon the plants, four of the front sides being supplied with plain, orange, blue, and red panes, respectively, and the remaining side being left open, with no screen whatever. The panes of glass used in these screens were the best samples of their respective colors which could be purchased. The blue, however, was really a purple, and the orange was a dark amber. Spectrophotometric measurements were made of these panes. * * *

The blue glass transmitted about 10 per cent of the red rays, less than 5 per cent of the yellow, while it was almost perfectly transparent to the blue rays. The red pane transmitted nearly 20 per cent of the red rays, very few of the rays lying between red and yellow, about 7 per cent of the yellow rays, while all the blue rays were cut off. Amber glass transmitted about 40 per cent of the orange rays, with a very small per cent of the green, and none of the blue. The plain or white glass transmitted 80 per cent of the red rays and about 70 per cent of the blue rays.

The first year's experiment was started late in winter, and little was learned from it except the proper methods of conducting the investigation. Trays of germinating radish seeds, in soil, were placed in the various fields at equal distances from the arc, and the behavior of the young plants was watched with interest. March 12, 1892, the plants being from 1 to 3 inches high and in seed-leaf, marked heliotropism was noticed in the morning, even when the light had stopped burning at 11 o'clock the previous evening. In the naked light the young plants pointed strongly towards the lamp. The red and white lights produced a little effect in drawing the plants towards the lamp, while in the blue field the effect was scarcely perceptible, and in the orange field not at all. On the morning of March 13, the results were about the same, except that the red and white lights seemed to have had more effect than on the previous night. It was apparent that the smallest plants were those in the

orange light. The next night the light burned but a short time, and on the following morning the plants all looked towards the sunlight. On the 15th the heliotropism toward the lamp was again marked. The best plants were those in the naked light, and the poorest those in the orange light.

On November 7, 1892, the electric lamp surrounded by the color screen was hung in front of a bed of lettuce plants, 4 feet above it and 3 feet from it, and burned about five hours each night. The plain glass and naked sections were out of range of the bed, and the other screens had caused no difference in the plants under their lights up to December 1. At this date the lamp was transferred to the opposite side of the bed and hung only a foot and a half above it, thus bringing all the five screens to bear upon the crop.

The position of the screens was also reversed in changing the lamp, save the blue, which occupied the middle portion of the frame. The light now began to influence the plants, especially by drawing or bending them towards it. This heliotropism was most marked in the blue field, somewhat less in the orange or amber field, and a trifle less in the red. A week after the lamp was moved, this influence was manifest; but at this time neither the plain screen nor the naked light seemed to have made an impression upon the lettuce plants. Three weeks after the moving of the light, however, decided differences had developed in the various fields. The plants in orange or amber light were the largest and best; these were followed, in order, by those in the red, blue, plain, and naked sections. The naked light had now begun to injure the plants seriously, a phenomenon which has been repeated throughout our experiments from the first. Early in January auxanometers, for measuring the hourly growth of plants, were started under the naked light, and in the red, blue, and orange fields, at equal distances from the arc. The machines were set in motion January 5, each being attached to the tip of a growing leaf about an inch and a half in length. On January 18 all the machines were changed on to new leaves. * * * [From the table] the short growth under the naked light is apparent at a glance. The red field gave second poorest results in the early part of the test, but it made remarkably large growth later on. At the time when these readings were begun the orange light had the largest plants, and the crop graded off through the red, blue, and plain lights; but about January 20 the differences were seen to be disappearing. The small plants were catching up. When the experiment was closed, January 31, all the fields were of nearly equal size, except the naked light plants which were still weak and small.

March 2, Grand Rapids forcing lettuce was placed in the beds under the various colored lights. The results were practically the same as before, but the differences were less marked, owing to the greater number of hours of sunshine and the fewer number of hours of electric light.

This experiment seems to show that lights of different colors exert decided influences upon radish and lettuce plants early in their growth; but these differences tend to disappear as the plants approach maturity. The naked light, as usual, was very injurious to the plants; but in no other case was the influence of the light sufficiently marked to make any important difference in the value of the crop.

Arrangements are now being made to grow plants in a spectrum during the coming winter.

Second report on the comparative merits of steam and hot water for greenhouse heating, F. W. CARD (*N. Y. Cornell Sta. Bul. No. 55, July, 1893, pp. 144–155*).—This article, with an introduction by

L. H. Bailey, contains a detailed account and tabulated data of an experiment conducted from December 29, 1892, to April 1, 1893, in which a forcing house was heated in alternate periods with steam and with hot water. The points considered were the average minimum night temperature within doors and without, the consumption of coal by each system, daily fluctuations of temperature within the house, the influence of pressure upon the temperature of steam pipes, the influence of crooks and angles on the temperature of hot water and steam pipes, the influence of length of pipe for both systems, and time required to heat up by both systems.

Three series of general comparisons were made between hot water and steam. From December 29 to January 16 the apparatus was used for hot water; from January 16 to February 10, it was used for steam. February 10 to 23 for hot water; February 24 to March 13 for steam. March 16 to 24 for steam; March 25 to April 1 for hot water. The last couplet concerns the comparative tests on the length of the run as influencing the behavior of steam and hot water.

With hot water the differences between the average minimum night temperature indoors and outdoors were for the three periods, $40\frac{41}{48}°$ F., $30°$, and $23\frac{2}{3}°$, respectively. With steam these differences were $30\frac{1}{17}°$, $29\frac{3}{7}°$, and $22\frac{3}{7}°$. The average difference was slightly greater for hot water than for steam; but the author thinks that all of this difference can not justly be attributed to the greater effect of the hot-water heating, because the greatest difference occurs in the first hot water test which was during very cold weather.

The length of run was extended in the last two periods by 84 feet. The hot water in passing to the further end of the long run lost $54\frac{8}{13}°$, while steam lost $7\frac{1}{15}°$.

Under the present conditions, which were strongly in favor of hot water, the following results can be deduced. It will be observed that they confirm several of the conclusions of last year.

(1) Hot water maintained a slightly greater average difference between the minimum inside and outside night temperature than steam.

(2) There was practically no difference in the coal consumption under the two systems.

(3) With a small plant like this, the fluctuations under both systems are much greater than in larger ones, and neither proved very satisfactory.

(4) The utility of slight pressure in enabling steam to overcome unfavorable conditions is fully demonstrated.

(5) The addition of crooks and angles is decidedly disadvantageous to the circulation of hot water and of steam without pressure, but the effect is scarcely perceptible with steam under low pressure.

(6) In starting a new fire with cold water, circulation commences with hot water sooner than with steam, but it requires a much longer time for the water to reach a point where the temperature of the house will be materially affected, than for the steam to do so.

(7) The length of pipe to be traversed is a much more important consideration with water than with steam.

(8) A satisfactory fall towards the boiler is of much greater importance with steam than the manner of placing the pipes.

Winter cauliflowers, L. H. BAILEY (*N. Y. Cornell Sta. Bul. No. 55, July, 1893, pp. 139–143*).—The first forced cauliflowers grown in the winter of 1890–'91 were checked in their growth when the plants were about 8 inches high, and after being removed into a higher temperature the sudden stimulus of the new growth caused the heads to split or "button," rendering them unfit for the market. In the following winter plants kept under a uniform condition of vigor and growth were successfully grown. In the winter of 1892–'93 two crops were grown in a low two-thirds-span house, 60 by 20 feet, on a bench with a board bottom and mild bottom heat. The plants were later, and the heads smaller and less uniform than those in solid beds.

In the same house on a bench with a ground bed and no bottom heat cauliflowers were successfully grown.

Seeds for the first crop were sown in boxes on August 24. The plants, having been once transplanted, were set in the beds October 4 and 5 about 16 inches apart each way. Three varieties were used, Extra Early Dwarf Erfurt, Gilt Edge Snowball, and Early Snowball.

The plants were watered two or three times a week, as occasion demanded, and the ground was frequently stirred with a hand weeder. An abundance of air was given during the day. * * * The first week in December heads were beginning to form. The first heads were sold January 13, four and a half months from the sowing of the seed. The Erfurt gave the earliest and evidently the best results. The plants had been checked somewhat late in their history by very dark weather and possibly by some inattention in management, and many of the heads began to "button" or to break into irregular portions with a tendency to go to seed. [January 20] nearly three fourths of the crop had matured sufficiently to give marketable heads, although many of the heads were small. * * * January 25, 1893, a second crop of cauliflowers was set in the beds, comprising Early Snowball and Dwarf Erfurt. Seeds for this crop were sown in flats October 21. On November 5 the plants were transplanted to other flats, and on December 16 shifted to 3-inch pots, where they remained until set in the bed. * * * About March 20 heads were found to be forming in the Early Snowball. A week later than this, Snowball had heads 3 or 4 inches in diameter while Erfurt showed none. The first heads were sold March 29, about five and a third months from the time of sowing. * * * Ninety per cent of the plants made good heads, which is a very large proportion, even for the best field culture. In this crop, the heads were allowed to attain a larger size than in the midwinter crop, the average diameter being about 6 inches. It is rarely necessary to bleach the heads, as is done in field culture.

A record of experiments in fruit culture, J. CLAYTON (*Alabama College Sta. Bul. No. 47, July, 1893, pp. 14*).—*Grapes* (pp. 3–5).—In 1886 48 varieties of grapes were planted on a northern exposure. Of most varieties 6 vines were planted. In 1893 all varieties were dead except those of which more than 100 vines had been planted originally, viz, Concord, Delaware, Ives, and Perkins.

On careful investigation July 1, 1893, we find we have: Concord, 60 dead, 44 living; Delaware, 7 dead, 93 living; Ives, 11 dead, 92 living; and Perkins, 29 dead, 72 living.

It will be seen from these figures that the Delaware and Ives are the most hardy, while the Concord and Perkins are reasonably so. These four make an admirable succession of fruit, the Perkins ripening early in July, then the Delaware and Concord, and last of all, the Ives.

In the new vineyard, with southern exposure, planted in 1889 (see Bulletin No. 29,

page 15), the results are almost identical. Out of 78 varieties planted only 17 are alive July 1, 1893, and of these, the four [above named] with the addition of the Martha, Norton Virginia, Empire State, Warren, and Cynthiana, are the only ones of any value.

[Green Mountain, Northern Muscat, and Moore Diamond are promising, but require further trial.]

Of the 8 varieties of the Rotundifolia or Muscadine type, planted in 1886 (see Bulletin No. 29, page 18), all are giving perfect satisfaction. By planting the ordinary Scuppernong, the Memory, the Mish, and Flowers, one can have a constant supply of this fruit until frost. The Memory and Mish are especially desirable, combining superior quality with vigorous growth and great productiveness. The Flowers has not the fine quality of the Memory and Mish, but being the latest to ripen is very valuable, and for wine making is unsurpassed by any grape.

Apples (pp. 5–8).—Of 45 varieties planted in 1886 only the following are recommended for general use: (1) Summer varieties—Red June, Red Astrachan, Early Harvest, Carolina Watson, and Horse; (2) fall varieties—Elgin Pippin, Simmons Red, Carter Blue, Kittageskee, Tuskaloosa seedling, Romanite, and Horn; (3) winter varieties—Hewes Virginia, Limber Twig, Stephenson Winter, Ben Davis or New York Pippin, and Wine Sap. Notes on the above varieties state the time of ripening and character of the growth and fruit. Lists are given showing the varieties making a good growth of tree but failing to fruit well, those badly attacked by blight, and those proving entire failures.

Pears (pp. 8, 9).—Of 45 varieties planted in 1885 all succumbed to pear blight except Kieffer, Garber Hybrid, Angouleme, Mount Vernon, and Winter Nelis. Large Duchess, Smith Hybrid, and Le Conte are not entirely dead, but probably too badly affected to recover.

Peaches (pp. 9–11).—In 1885 there were planted 37 varieties of budded trees and 50 seedlings. A few died in transplanting, and later 3 budded trees died. July 1, 1893, all varieties were in a healthy condition. Notes are given on the following varieties, which in the order named furnish "a complete succession from June to November:" Alexander, Hale Early, Early Tillotson, Parnell Nos. 1 and 2, Amelia, Burke, Crawford Early, Stump the World, Thurber, Elberta, Arietta, Duggar Golden, General Lee, Stonewall Jackson, Crawford Late, Eaton Golden, Denning September, Stinson October, and Hudson November.

Plums (p. 11).—Of 13 varieties planted in 1885, only the Wild Goose grafted on peach stock, the Weaver, Southern Golden, and Hattie were living July 1, 1893. Nine varieties of the Japan type were planted in 1889, 4 of which bore their first crop in 1892.

Quinces (p. 11).—Of 5 varieties planted in 1885, only the Champion and the Chinese or Quincedonia have borne fruit.

Cherries (p. 12).—Of 8 varieties tested all proved failures.

Mulberries and nut-bearing trees (p. 12).—Only 2 varieties of mulberries, Hicks and Claude, are recommended. Pecans, English walnuts, and black walnuts are growing well on the station grounds.

Raspberries (p. 12).—Of 16 varieties of Red Cap raspberries tested, Turner and Cuthbert are preferred.

Strawberries (pp. 12, 13).—From the long list of different varieties of strawberries tested on the experiment grounds (see Bulletins No. 2, 1887, and No. 2, 1888, old series, and Bulletins Nos. 1, 20, and 29, new series of the station), the following six have proved most successful and desirable:

Sharpless, Wilson, Belmont, Bubach, Eureka or 1001, Haverland.

Melons (p. 13).—Twenty-eight varieties of watermelons have been tested. Those most prized are Cuba, Sugar Loaf, Jones, Pride of Georgia, Cuban Queen, and Jordan Gray Monarch, in the order named. Kolb Gem is recommended only for shipping. From 30 varieties of cantaloupes the following have given satisfaction: Improved Pine Apple, Nutmeg, Netted Gem, Extra Early Hackensack, Baltimore or Acme, Atlantic City, and Nixon.

Small fruits, A. B. McKAY (*Mississippi Sta. Bul. No. 26, Aug., 1893, pp. 15*).—*Strawberries* (pp. 3–14).—Notes on 38 varieties and directions for planting, cultivating, mulching, and renewing old plantings. The most promising varieties are mentioned in the following summary:

Charleston, Hoffman, Michel, and Crescent are among the earliest varieties; Cloud, Finch, Windsor Chief, Wilson, and Sucker State are midseason; Enhance, Cumberland, Gandy, McNeill, Michel, and Bubach are among the latest bearers. Among the best shippers are Charleston, Hoffman, Cloud, Enhance, Bubach, Gandy, and Finch. For local market and home use plant Cumberland, McNeill, Gandy, Enhance, Michel, Bubach, and Monmouth.

Though planting in cloudy, wet, summer weather, or in midwinter was fairly successful the best results were secured by planting soon after the first of October, and in February and March. The plants are allowed to become matted on a space 12 to 15 inches broad. Early in the season the space between the rows is broken deeply, after which all cultivation is shallow. Good results were obtained by sowing cowpeas between the rows late in July.

For mulching purposes we have found nothing equal to cotton-seed hulls. Two and a half to 3 tons are required to the acre. * * * The hulls are put on during February, and are spread on just thick enough to hide the soil well between and around the plants. On the sides of the rows the hulls should extend about 4 inches beyond the line of the surface covered by plants. * * *

To renew old plantings where there is a sufficient number of new plants between the rows, * * * just after harvest, with a sharp plow, cut away all the plants except those that will remain within a 4 to 6 inch strip along one side of the old row; thin to proper width and treat as a new planting. By renewing each season in this manner, on choice land, six, and even eight, successive harvests may be made from the same soil before it goes to other crops.

Gooseberries and currants (p. 14).—Four varieties of each were planted on a yellow loam soil with clay subsoil. At the close of the second season there were few gooseberry plants and no currant plants alive.

Raspberries (p. 14).—In the fall of 1888, 7 varieties were planted. Only the Cuthbert and Turner Red survived the second season, and the stands of these were poor at the end of the third season.

Blackberries (p. 15).—Of the 5 varieties planted in 1888, only Kittatinny and Lawton proved satisfactory. Both of these varieties, after bearing three heavy crops, were in the next two seasons almost destroyed by red rust. Lucretia, planted in 1890, bore one heavy crop and has remained so far free from rust.

Analyses of figs, M. E. JAFFA and G. E. COLBY (*California Sta. Bul. No. 102, June, 1893, pp. 1–6*).—"The growing importance of the fig industry in California" demanded that this fruit should be studied in accordance with the plan already followed with respect to other California fruits and reported in Bulletins Nos. 93, 97, and 101 of the station (E. S. R., vol. III, p. 78; IV, pp. 157, 918). For this purpose 11 of the most important varieties of the crop of 1892 were selected and examined. These included White Adriatic (2), Smyrna (2), California Black, Hirtu du Japon, Constantine, Du Roi, Doree Narbus, Pasteliere, and Brunswick (?).

The following tables give the average results of physical and chemical examination of these varieties.

Average analyses of figs.

	Average of 11 analyses.
PHYSICAL ANALYSIS.	
Average weight ... grams..	37.70
Number ... per pound..	14.75
Juice, pressed ... per cent..	74.35
Pulp, pressed ... do....	25.65
CHEMICAL ANALYSIS.	
Sugar in juice by copper test ... per cent..	21.42
Sugar in fresh fruit ... do....	15.73
Acid in juice (calculated as SO_3) ... do....	0.14
Nitrogen in whole fresh fruit ... do....	0.20
Albuminoids in whole fresh fruit ... do....	1.25
Ash in whole fresh fruit ... do....	0.62
Water in whole fresh fruit ... do....	81.84

Ash analyses of figs.

	White Adriatic.	Smyrna.
	Per cent.	*Per cent.*
Pure ash	0.897	....
Composition of pure ash:		
Potash	60.13	48.60
Soda	1.17	2.20
Lime	9.12	....
Magnesia	5.32	....
Iron oxide	0.84	....
Manganese oxide	0.19	....
Phosphoric acid	11.07	11 20
Sulphuric acid	4.75	....
Silica	4.85	....
Chlorine	2.55	....
Total	99.99	....
Less excess of oxygen due to chlorine	0.63	....
Total	99.36	....

Proportion of juice to pulp.—The juiciest fruit, White Adriatic, had over 85 per cent of juice; the driest sample, Smyrna, contained but 64 per cent of juice.

Sugar and acid contents of the juice and fruit.—In the whole fruit, the highest sugar is seen in White Adriatic; however, the juice of one Smyrna variety shows 29.90 per cent sugar, which when referred to the fresh fruit is still over 1 per cent less than that of the White Adriatic, or as 19.20 to 20.45 per cent. Doree Narbus and Constantine, with respectively 27.40 and 24.04 per cent sugar in their juice, show, on account of their dry flesh, much less sugar, in whole fruit, than either of the Adriatics. Another Smyrna variety has the lowest sugar percentage, amounting to but 8.0 in the whole fruit, some 4.5 per cent less than the California Black with 12.40. * * *

The acid of the figs, expressed in terms of sulphuric (SO_3) for the sake of comparison, seems to be very much lower than that found in any of our other fruits.

Nutritive values.—As heretofore pointed out in Bulletin No. 101, the fig rates first in flesh-forming materials among our fruits; apricots and plums, second; prunes and oranges, third.

Ash composition and nitrogen content.—As to nitrogen, it is readily seen that among our fruits, the figs, on the whole, draw decidedly the highest amount and are quite like those of foreign production in this regard. * * *

With the exception of the grape, it seems that the fig draws rather more heavily upon the mineral ingredients that will need to be replaced by fertilization than do any of the other fruits we have examined. * * *

In the ashes of the fig, as in the prune, apricot, orange, and lemon, we find potash to be the leading ingredient, amounting to about three fifths of the whole ash. * * *

The fig, like the lemon, appears to range a little below the other fruits in its draft upon phosphoric acid, for we find the ashes to stand in the following order in their phosphoric acid percentages, viz: Prunes, 14.1; apricots, 13.1; oranges, 12.4, and lemons and figs, 11.1.

Report of the horticulturist, S. T. MAYNARD (*Massachusetts Hatch Sta. Report for 1892, pp. 156, 157*).—*Fruits* (pp. 156, 157).—Among the new varieties tested none of preëminent merit were found.

Taking the old and new varieties together, those that our tests lead us to pronounce the most valuable for general market and home use are as follows, given in the order of ripening:

Apples.—Red Astrachan, Gravenstein, Haas Baldwin, Rhode Island Greening, Roxbury Russet.

Pears.—Giffard, Clapp, Bartlett, Bosc, Sheldon, Anjou, Lawrence, Dana Hovey.

Peaches.—Amsden (on account of hardiness of buds), Early Rivers, Crawford Early, Crawford Late, Mountain Rose, Oldmixon, Crosby (Excelsior), Stump.

Plums.—Bradshaw, McLaughlin, Lombard, German Prune.

Quinces.—Orange, Rea Mammoth.

Grapes.—Moore Early, Worden, Concord, Delaware, Winchell (Green Mountain).

Blackberries.—Agawam, Snyder, Taylor, Erie.

Black-cap raspberries.—Soheugan or Doolittle, Gregg, Nemeha, Crawford.

Red raspberries.—Marlborough, Hansell, Cuthbert.

Currants.—Versaillaise, Cherry, Fay Prolific.

Strawberries.—Beder Wood, Bubach, Haverland, Sharpless.

Greenhouse experiments (p. 157).—Experiments in overhead *vs.* underbench piping have been continued with about the same results as for the past two years. For an account of previous experiments see Bulletin No. 15 of the station (E. S. R. vol. III, p. 289.)

"Fertilizers for the greenhouse have been experimented with, but no results have been reached at this time other than those reported in previous bulletins."

FORESTRY.

The forest tree plantation, T. J. BURRILL and G. W. MCCLUER (*Illinois Sta. Bul No. 26, May, 1893, pp. 205–244, plates 3*).—The bulletin is a report on the experimental forest plantation begun in 1871. The first official act in the establishment of the experiment was a report to the university board by the committee on horticulture in November, 1868, advising that some steps be taken to begin experiments in the cultivation of useful forest trees. On March 11, 1869, the legislature passed an act setting aside $1,000 for the purchase of trees and seeds. The following kinds of trees have been planted: Basswood, ailanthus, soft maple, hard maple, box elder, honey locust, hardy catalpa, tender catalpa, green ash, white elm, osage orange, white walnut, black walnut, small-nut hickory, large-nut hickory, burr oak, chestnut, white willow, white pine, Austrian pine, Scotch pine, Norway spruce, European larch, and red cedar. Most of the trees were purchased as seedlings, one to three years old, and allowed to remain in the nursery for two years, but some were planted immediately in the experimental plats. In other cases seeds were planted where the trees were to grow. They were all planted in rows, usually 4 feet apart and 2 feet in the row, cultivated, trimmed, and thinned from time to time. Details of method of planting, cultivation, etc., are given. The forest record for 1871 shows 7 acres planted with 36,749 trees at a total cost of $583. In 1872 many trees were replanted and new ones added. In this year 10,083 trees were added, and, with the cultivation given, the whole cost for the year was $371.40. In 1876 the total cost from the beginning had been $1,466.97. In 1886 nearly 12$\frac{1}{6}$ acres had been planted and cultivated at a total cost of $1,846.87. There had been sold trees to the value of $183.25, making a net cost for the fifteen years of $1,663.62. Of the trees planted the following are now in excellent condition and very promising: Black walnut, box elder, hardy catalpa, larch (growing on high ground), hard maple, Scotch pine, white pine, Norway spruce, and white willow. The others planted are only in fair condition, excepting alianthus, white walnut, tender catalpa, and larch (growing on low ground). These are in poor condition. A detailed account of the history and present condition of each variety is given. The best trees average now from 4 to 10 inches in diameter, while some are 16 to 18 inches, and one, a white willow, 23 inches in diameter.

The conclusions of the authors are as follows:

Under present circumstances it seems impossible for forest tree plantations to be profitable as a farm crop on land fit for wheat and corn. It is idle to talk of growing wood for fuel—except on farms, for home use—when good bituminous coal can be had at present prices. The fact is, in Illinois, though the extent of the natural forests has been vastly diminished, the price of cord wood does not advance.

Lands, even though well timbered, sell at a less price per acre than adjoining lands of the same quality that have been cleared, or than prairie lands of the same productiveness. The value of the timber in such places is less than the cost of clearing and bringing under cultivation. It must, however, be recognized that the value of natural forests gives little information as to the worth of artificial plantations. The former may be mainly composed of what is in the locality most prized; but it is usual that a small proportion only of the trees are those commanding the highest price. In the artificial plantation, judiciously managed, the whole may be high-priced, useful material; this, too, may be more readily accessible and within easy reach of the market.

Let it be clearly understood that in the foregoing tree-growing for timber has been the point discussed. But the planting of trees has other and higher claims. Whether or not the actual amount of rainfall is modified by forests, there is not the slightest doubt but that the climate is affected. The temperature is equalized; the extremes of heat and cold are not so great. The air is modified as to the amount of moisture, especially in dry times in summer. The moisture of the soil is better distributed through the year. The running streams are better sustained, and also less subject to destructive floods, where the country is well timbered than where the land is kept bare by cultivation and the surface so drained that the water runs away at once. Heavy winds are greatly checked, much to the comfort of man and animals. Crops are preserved in various ways from the destructive influence of air moving too rapidly. Lastly, trees for the ornamentation of the home area, as well as for the wide expanse of the country itself, can never be neglected by a people whose cultured tastes and educated perceptions give them pleasure in the beautiful and the picturesque. To one who has no love for trees as such, half their value is lost. He who can see nothing but wood for fuel or for the manufactory in a shady grove sees nothing but the dullest and poorest side of life. While it must be insisted that the figures presented by theorists as to the value of timber as a crop are extravagant, and by no means a proper basis for business, tree-planting for the many and varied purposes of health, comfort, and pleasure, with financial profit as a subordinate factor, should be studied and practiced by individuals, communities, and nations. It is to be hoped that the experiment of which this account is made will not be considered worthless if the expenditures are never equaled by the receipts.

There is one reason for uneasiness about this experiment, as there must be about every forest tree plantation. The matter is so serious that this report ought not to be closed without a word upon it. The danger of fire is a real and imminent one. The areas bearing the conifers are liable to be burnt over during any dry time, and in autumn, after the fall of the leaves, the portions devoted to deciduous trees are quite as unsafe. A burning wad from a gun, a spark from a pipe, a negligent use of fire by a tramp, may be sufficient to start a conflagration which shall destroy within a few hours the products of years and decades. The incendiary has an abundant chance for the practice of his most despicable and criminal acts. * * * It is impracticable to gather the fallen leaves and branches, which, moreover, are necessary as a mulch for the best growth of the trees. There seems to be little offered but to take the risk. If so, this must be included among the items of obstacles and expenses.

SEEDS.

WALTER H. EVANS, *Editor.*

Experiments in germination of treated seed, W. A. KELLERMAN (*Ohio Sta. Bul., vol. I, No. 3, tech. ser., Apr., 1893, pp. 201–206*).—Several lots of corn, oats, and wheat were treated with hot water (132° F.) for fifteen minutes, ½ per cent solution of potassium sulphide for eight

hours, and the same solution for twenty-four hours. The tests were begun in July, 1891, and repeated at intervals of five and one half, thirteen and one fourth, and seventeen and three fourths months. Wooden trays partly filled with sand were used in the tests. The seeds were placed on top of the sand and kept sufficiently moist. In every case the treated seeds were compared with untreated. The following table gives the results obtained by the author:

Germination of seed at intervals after treatment.

When tested.	Treatment.	Percentage germination.											
		Corn.				Oats.				Wheat.			
		First day.	Second day.	Third day.	Eighth day.	First day.	Second day.	Third day.	Eighth day.	First day.	Second day.	Third day.	Eighth day.
At time of treatment	Check	0	12	35	100	0	32	81	99	....	....	....	....
Do	Hot water	0	23	53	100	0	59	76	97	....	....	....	....
Do	Potassium sulphide, 8 hours.	0	36	70	100	0	59	81	91	....	....	....	....
Do	Potassium sulphide, 24 hours.	42	85	97	100	10	58	74	75	....	....	....	....
5½ months after treatment.	Check	0	1	29	99	0	51	87	99	34	93	98	99
Do	Hot water	0	5	37	99	1	68	93	99	10	59	79	97
Do	Potassium sulphide, 8 hours.	0	0	14	97	0	78	93	98	36	86	91	93
Do	Potassium sulphide, 24 hours.	0	0	1	75	0	72	83	87	30	89	93	95
13¼ months after treatment.	Check	0	70	97	97	1	60	79	85	45	83	86	87
Do	Hot water	0	38	98	99	0	56	77	85	5	67	78	89
Do	Potassium sulphide, 8 hours.	0	33	92	97	0	37	52	70	49	72	76	76
Do	Potassium sulphide, 24 hours.	0	2	15	66	0	25	33	56	32	60	63	65
17¾ months after treatment.	Check	0	0	13	97	0	6	27	35	0	41	61	69
Do	Hot water	0	0	27½	100	0	1½	27½	53	0	23½	47	57
Do	Potassium sulphide, 8 hours.	....	....	....	....	0	0½	10	33	0	36½	51	54
Do	Potassium sulphide, 24 hours.	0	0	0	35	0	1	10	29	0	36	50	58

In the above table the results obtained from the seed soaked for twenty-four hours in potassium sulphide solution are relatively too high for the first day's germination, as they have really a day's start of the other seeds. The same is partly true for those soaked for eight hours. The author's conclusions are as follows:

The treatment of seed with either of the two smut fungicides—hot water (132° F., 15 minutes) and potassium sulphide (½ per cent solution)—is to be recommended for hastening the germination of the seeds and to induce the plant to pass as quickly as possible the period of greatest vulnerability to smut infection, namely, the earliest stage of the seedling when it is extremely delicate.

The treated seed generally shows a better germination than untreated seed. The germination at the end of a few months is scarcely as favorable and after a long interval it is plainly inferior.

Whether the explanation of better germination of treated seed is to be sought for in some possible change in the testa or seed coats, or portions exterior to the embryo, perhaps rendering them better moisture-absorbing agents, is not known. The explanation referred to above, namely, the development of an enzyme by gentle

heat, though it may account for the better germination in case of the seed treated with hot water, evidently would be no explanation for the improved germination of the seed treated with potassium sulphide, since in the latter case no heat was applied and water of ordinary summer temperature of rain water stored in a cistern was used.

WEEDS.

WALTER H. EVANS, *Editor.*

Colorado weeds, C. S. CRANDALL (*Colorado Sta. Bul. No. 23, Apr., 1893, pp. 12, plates 12*).—A popular statement is made regarding weeds, their habits, and distribution. The provisional list of weeds, as compiled by the author, embraces 228 species and varieties, representing 141 genera and 42 orders. The orders most abundantly represented are *Compositæ*, *Leguminosæ*, *Gramineæ*, and *Polygonaceæ*.

A tabulated classification is as follows:

Classification of species of Colorado weeds.

Duration.	Native.	Foreign.	Total.	Degree of badness.	Native.	Foreign.	Total.
Perennial	98	30	128	Worst weeds	27	29	56
Biennial	11	7	18	Bad weeds	55	26	81
Annual	46	43	89	Indifferent weeds	66	25	91

Detailed descriptions, illustrations, and methods suggested for eradication are given for the following: Shepherd's purse (*Capsella bursa-pastoris*), cow herb or cockle (*Saponaria vaccaria*), small-flowered gaura (*Gaura parviflora*), gum plant or rosin weed (*Grindelia squarrosa*), poverty weed (*Iva axillaris*), *I. xanthiifolia*, beaked horse nettle or buffalo bur (*Solanum rostratum*), *Fransera discolor*, and squirrel-tail grass, foxtail, or wild barley (*Hordeum jubatum*).

DISEASES OF PLANTS.

WALTER H. EVANS, *Editor.*

Report of the botanist of Vermont Station, L. R. JONES (*Vermont Sta. Report for 1892, pp. 56–88, plates 4, figs. 3*).

Synopsis.—A report on investigations of the following diseases: (1) Potato diseases, (2) oat smut, (3) orchard diseases, (4) a cucumber spot disease, and (5) greenhouse diseases.

Potato diseases (pp. 57–72).—The author gives a report on a comparative test of twelve fungicides for potato rot (*Phytophthora infestans*), early blight (*Macrosporium solani*), and potato scab. The investigations were in the line of those given in the Annual Report of the station for 1891 (E. S. R., vol. IV. p. 471), and were the chief investigations for the year. For the potato rot or late blight (*Phytophthora infestans*), tests were made in three fields with the following fungicides: Copper soda solution, verdigris solution, Bordeaux mixture with molasses, ammoniacal copper

carbonate, strong Bordeaux mixture, weak Bordeaux mixture, very weak Bordeaux mixture, copper and ammonium carbonates, glue mixture, modified eau celeste, copper carbonate in suspension, and copper chloride solution, formulas for all of which are given. The plats were staked out July 30, and the first application of fungicides was made on that day. Three weeks of rainy weather followed. August 10 the first evidence of the rot was noticed in one of the check plats, and by August 12 every check plat was plainly affected. The second spraying was given August 13 in the same order as before, except that the verdigris solution was reduced one half, the stronger solution plainly injuring the foliage. August 25 the third application was made, similar to the second. Only two thirds of the plats were treated the third time, in order to test the value of two and three applications of the fungicides. September 8 every leaf in the check plats was dead, some of the treated plats were affected, and others showed no trace of disease. When dug, the differences in the yields were no less striking than those in the appearance of the tops. Judging from the appearance of the plants in the different plats and the yields, the fungicides are ranked in the following order of merit:

Relative value of fungicides for potato rot.

Rank.	Fungicide.	Remarks.
1	Strong Bordeaux mixture	These four are the only ones of sufficient merit to recommend them for practical use.
2	Bordeaux mixture and molasses	
3	Weak Bordeaux mixture	
4	Modified eau celeste	
5	Copper soda solution	These were all beneficial, most of them to a profitable degree, but not to be ranked with the other four.
6	Verdigris	
7	Very weak Boadeaux mixture	
8	Precipitated copper carbonate	
9	Copper and ammonium carbonate	
10	Glue mixture	
11	Copper chloride	
12	Ammoniacal copper carbonate	

By taking all the plats sprayed with the best fungicides and comparing them with their checks, the author finds a gain of 113 bushels, or 103 per cent, in the yield per acre. In the test of two and three applications there was a total gain of 79 per cent in favor of three applications. This does not indicate that a similar gain would always be secured. Climatic influences undoubtedly will have some effect. The author found about 400 gallons necessary for three applications to an acre. The cost of materials and application averaged $7 per acre. The decreased production is attributed, not to the rotting of the tubers alone, but especially to the premature death of the diseased vines.

The early blight caused by *Macrosporium solani* was more troublesome in 1892 than during the preceding year. Its early appearance and spread during cool, dry weather serves to distinguish it from the rot caused by the *Phytophthora*. The author thinks the early and repeated application of Bordeaux mixture may serve to keep it in check.

This is to be a subject for further investigation. Planting the main crop not earlier than May 15 and spraying the plants two or three times during August will secure a large crop free from blight or rot.

Potato scab was investigated, with results as given in the table below. Plats 1–4 were planted with very scabby seed. The seed used in plats 2, 3, and 4 was soaked one and one half hours in 0.001 per cent solution of corrosive sublimate. The ground used was a clay sod, having been in grass for seven years. The amount of scab was small in all parts of the field.

Results of different treatments for potato scab.

No. of plat.	Kind of seed.	Treatment of seed.	No. of pieces planted.	No. of hills dug.	Per cent of the pieces planted that grew.	Large tubers smooth.		Large tubers slightly scabby.		No. of small tubers smooth.	No. of small tubers slightly scabby.
						Number.	Weight.	Number.	Weight.		
							Lbs.		*Lbs.*		
1	Scabby	None	132	112	85	326	$75\frac{1}{4}$	35	9	198	25
2	...do	Washed, then disinfected, then cut.	127	115	90	250	$68\frac{7}{8}$	97	$22\frac{7}{8}$	102	23
3	...do	Washed, then cut, then disinfected.	132	52	40	127	$45\frac{1}{2}$	......	......	29	......
4	...do	Cut, then disinfected (not washed).	132	93	70	262	$73\frac{1}{8}$	6	$1\frac{3}{4}$	66	2
5	...do	(a) Sprayed with Bordeaux mixture in furrow.	66	64	97	154	$40\frac{1}{4}$	18	$4\frac{1}{8}$	42	8
		(b) Soaked a half hour in Bordeaux mixture.	66	62	94	208	$48\frac{3}{4}$	7	$1\frac{7}{8}$	89	6
6	Smooth	Placed manure in furrow, dropped seed on this, then sprayed as in 5*a*.	132	115	87	327	$81\frac{3}{4}$	54	$14\frac{3}{8}$	99	15
7	...do	Untreated, check of 6	132	121	91	338	$84\frac{3}{4}$	85	$19\frac{5}{8}$	75	30

Oat smut (pp. 73–82).—The tests of remedies for smut described in the Annual Report of the station for 1891 (E. S. R., vol. IV, p. 471), were continued in 1892. Hot water and a solution of potassium sulphide were used, with results similar to those obtained the previous year. Contrary to the general belief that treatment of smutted oats increases the yield, the author found in some cases that it caused a decreased yield. In general the oats of Vermont do not contain sufficient smut to pay for the treatment. Oats grown from Western seed, however, show a very much greater amount of smut. The season of 1892 was an unfavorable one for smut, and this may have influenced the results.

Orchard diseases (pp. 82–84).—A report is given of unsuccessful spraying for apple scab. The weather was unfavorable, rain washing the solution almost immediately from the trees. The appearance of the brown spot disease of apples (*Phyllosticta pirina*) is noted. The uprooting of all red cedar trees within a radius of a mile about an orchard previously badly infested by *Rœstelia pirata* secured an entire absence of that fungus. This point is interesting, as showing that the mycelium of the fungus is not perennial in the apple.

Spot disease of cucumber (p. 84).—This disease is reported as especially destructive in some localities, first appearing on white spine varieties. It is due to *Cladosporium cucumerinum*. No remedy is suggested.

Greenhouse diseases (pp. 84–88).—Lettuce rots are reported as follows: *Botrytis vulgaris*, a disease somewhat similar to the *Botrytis*, a bacterial disease, and ordinary damping off, due to *Pythium debaryanum*. The new disease, resembling the usual *Botrytis* rot, is characterized by the author as follows:

This trouble has been worse in the experiment station greenhouse on the head varieties, but has attacked all more or less seriously. The disease appears first at the tips and edges of the inner or heart leaves. Its distinction from the other trouble should therefore be easy. In the tender, moist leaves at the heart the trouble first shows itself as a watery decay at or just inside the margin near the tip, this marginal portion often becoming limp. In leaves more exposed the tissues blacken soon and become crisp as they die. The decay then passes backward, especially along the veins. This progress is generally rather slow, and as the leaves are growing very fast at this stage they become curled. Often a growth of the *Botrytis* appears upon these diseased leaves, hastening their decay; but this is a secondary attack, and not the primary cause of the trouble. The characters of the disease suggest rather its bacterial nature primarily. Investigations of this matter are in progress, but are not, however, ready for publication.

A bacterial disease is reported, due the author thinks to some species of *Bacterium*. Inoculations seem to transmit the disease, but it can be prevented by proper attention to temperature and moisture of the house.

The œdema of the tomato, described in Bulletin No. 53 of the New York Cornell Station (E. S. R., vol. v, p. 55) is mentioned as occurring in the station greenhouse. It is due to insufficient light, too much moisture in the soil, and the temperature of soil and air being too nearly equal. Attention to these points will prevent the occurrence of this disease.

Report on fungicides, insecticides, and spraying apparatus, S. T. MAYNARD (*Massachusetts Hatch Sta. Report for 1892, pp. 157, 158*).—Bordeaux mixture and ammoniacal carbonate of copper as fungicides and Paris green as an insecticide have given the most satisfactory results.

Plum knot was largely prevented by pruning and application of kerosene and Bordeaux mixture. Experiments with fungicides show that poplar rust can be controlled. Bordeaux mixture for carnation rust gave very satisfactory results. The use of simple solutions of copper sulphate, suggested in Bulletin No. 21 of the station (E. S. R., vol. IV, p. 918) has not been satisfactory, the foliage in nearly every case being injured by it.

Various spraying pumps and nozzles were tested during the past season.

ENTOMOLOGY.

Report of the entomologist, C. H. FERNALD (*Massachusetts Hatch Sta. Report for 1892, pp. 148–151*).—A beneficial fly (*Scenopinus fenestralis*), the larvæ of which feed on the larvæ of clothes moths and the buffalo carpet beetle, is reported on. It was thought to be destructive to woolens, but there is no evidence to substantiate this idea. This insect is described as follows:

The larva is about eleven sixteenths of an inch in length, as large as an ordinary pin in the middle, and gradually tapering towards each end. The head is conical, nearly twice as long as broad, and of a reddish-brown color, while the body is whitish translucent, and together with the head comprises apparently twenty-one segments. There are a few short hairs on the head and on each side of the three following segments. There are also a few hairs on the twentieth segment, and a pair of anal prolegs on the last segment, which is smaller and shorter than the one before it and easily overlooked. The adult fly is about one fifth of an inch in length, metallic-black in color, with dull yellowish-brown legs and slightly gray wings.

A destructive cut worm (*Nephelodes minians*) is reported as proving very injurious to grass fields. A detailed report is promised at some future time. It is briefly described as follows:

This caterpillar is about one and three fourths inches in length when full grown, and quite stout, tapering slightly from the middle towards each end. The head and top of the second segment are very dark brown, and the body of a glossy bronze-green color, with lighter longitudinal stripes. They feed by night on corn, grasses, and knotweed, remaining concealed during the day under pieces of boards or in any other convenient hiding place. They pass the winter as partly grown caterpillars, and specimens bred at the insectary reached their full growth and pupated August 4, and the moths emerged September 2 of the second year.

Experiments were conducted to ascertain whether the Gypsy moth could be wholly exterminated with Paris green. The results obtained show that it can not be relied upon to wholly destroy the caterpillars, but that other remedies must be used in connection with it. Caterpillars were found capable of living from one day to two weeks upon poisoned leaves. The time seems to vary with the different molts.

Some injurious insects of the apple, C. E. CHAMBLISS (*Tennessee Sta. Bul. vol. VI, No. 1, pp. 29, figs. 19*).—A popular bulletin on the subject of apple insects and means for their repression. The following are popularly described, figured, and their life history given, together with suggested means for their destruction: Woolly louse of apple (*Schizoneura lanigera*), round-headed borer (*Saperda candida*), flat-headed borer (*Chrysobothris femorata*), bucculatrix (*Bucculatrix pomifoliella*), leaf crumpler (*Mineola indiginella*), tent caterpillar (*Clisiocampa americana*), tussock moth (*Orgyia leucostigma*), yellow-necked caterpillar (*Datana ministra*), spring cankerworm (*Paleacrita vernata*), fall cankerworm (*Anisopteryx pometaria*), codling moth (*Carpocapsa pomonella*), and apple curculio (*Anthonomus quadrigibbus*).

Spraying machines are described and formulas for insecticides given.

A few common insects, C. P. GILLETTE (*Colorado Sta. Bul. No. 21, July, 1893, pp. 16, figs. 12*).—A popular bulletin containing descriptions and suggested remedies for the following insects: Imported cabbage worm (*Pieris rapæ*), Southern cabbage butterfly (*P. protodice*), cabbage plusia (*Plusia brassicæ*), cabbage plutella (*Plutella cruciferarum*), two-striped flea beetle (*Systena tæniata*), Colorado cabbage flea beetle (*Phyllotreta albionica*), onion thrips (*Thrips striatus?*), and *Caleothrips trifasciata*.

Locusts and the horn fly, G. C. DAVIS (*Michigan Sta. Bul. No. 98, July, 1893, pp. 9, figs. 3*).—A popular bulletin giving descriptions, life history, and treatment of the red-legged locust (*Melanoplus fermur-rubrum*), two-striped locust (*M. bivittatus*), and the horn fly (*Hæmatobia serrata*).

Catalogues of West Virginia Scolytidæ and their enemies, A. D. HOPKINS (*West Virginia Sta. Bul. No. 31, Apr., 1893, pp. 121–168*).—The bulletin gives an account of the habits of bark, twig, and timber beetles. The damage done by these insects is also calculated. Special investigations have been begun on the pine-bark beetle (*Dendroctonus frontalis*), the spruce-bark beetle (*Polygraphus rufipennis*), and the European fruit-bark beetle (*Scolytus rugulosus*). Lists are given of 80 species of bark, twig, and timber beetles, with abridged notes as to their habits, hosts, enemies, and time and place of collection; 48 species of predaceous and parasitic enemies found with the beetles, together with their hosts and date of collection; the trees and shrubs infested by the *Scolytidæ*, with the insects preying on each.

Description of Chlorops ingrata, n. sp., S. W. WILLISTON (*Ohio Sta. Bul. vol. I, No. 3, tech. ser., Apr., 1893, pp. 156, 157*).—A technical description of this new insect reared from galls on *Muhlenbergia mexicana*.

Notes on species of Ohio Hymenoptera and Diptera hitherto undescribed, F. M. WEBSTER (*Ohio Sta. Bul. vol. I, No. 3, tech. ser., Apr., 1893, pp. 157, 158, figs. 4*).—Biological notes are given on the following insects: *Heptameris oscinidis*, *Apanteles orgyiæ*, *Megorismus lasiopteræ*, *Meraporus bruchivorus*, *Catolaccus tylodermæ*, *Arthrolytus apatelæ*, *Ericydnus maculipennis*, *Encyrtus clisiocampæ*, *Websterellus tritici*, *Elachistus websteri*, *Hemiletes drassi*, *Haltichella* sp., *Aphelinus mali*, *Chlorops ingrata*, and *Sarcomacronychia trypoxylonis*. The hosts on which most of these are parasitic are given in most cases.

Description of Lasioptera muhlenbergiæ n. sp., J. MARTEN (*Ohio Sta. Bul. vol. I, No. 3, tech. ser., Apr. 1893, pp. 155, 156, fig. 1*).—A technical description of a new gall-making fly reared from galls on *Muhlenbergia mexicana*.

Descriptions of new Hymenoptera bred by F. M. Webster, W. H. ASHMEAD (*Ohio Sta. Bul. vol. I, No. 3, tech. ser., Apr., 1893, pp. 159–165*).—Technical descriptions are given of the following: *Heptameris oscinidis*, *Apanteles orgyiæ*, *Megorismus lasiopteræ*, *Meraporus bruchi-*

vorus, Catolaccus tylodermæ, Arthrolytus apatelæ, Ericydnus maculipennis, Encyrtus clisiocampæ, E. pleuralis, and *Websterellus tritici.*

Description of Sarcomacronychia trypoxylonis, C. H. T. TOWNSEND (*Ohio Sta. Bul. vol. I, No. 3, tech. ser., Apr., 1893, pp. 165, 166*).—A technical description of a new species reared from cells of a species of mud-dauber wasp (*Trypoxylon politum*).

A dipterous gall-maker and its associates, F. M. WEBSTER (*Ohio Sta. Bul. vol. I, No. 3, tech. ser., Apr., 1893, pp. 154, 155, fig. 1*).—A list of insects bred from galls on *Muhlenbergia mexicana.* They are *Lasioptera muhlenbergiæ, Chlorops ingrata, Pteromalus sp., Ericydnus maculipennis,* and *Megorismus lasiopteræ.*

Methods of oviposition of Tipulidæ, F. M. WEBSTER (*Ohio Sta. Bul. vol. I, No. 3, tech. ser., Apr., 1893, pp. 151–154, figs. 13*).—The opinions of different authorities are given as to the observed methods of oviposition of species of *Tipulidæ* as reported by various authors. The terminal abdominal segments of *Tipula bicornis* and *Pachyrrhina* sp. are described and figured, and the habit of oviposition as observed in confinement is given by the author. The eggs of both species are described.

FOODS—ANIMAL PRODUCTION.

E. W. ALLEN, *Editor.*

Analyses of feeding stuffs, J. L. HILLS (*Vermont Sta. Report for 1892, pp. 34, 35*).—Tabulated analyses of cream gluten, corn germ meal, Buffalo gluten feed, ground wheat screening, dairy middlings, Chicago gluten meal, Chicago maize feed, Cleveland concentrated meal, and Cleveland standard dairy feed.

Analyses of maple sugar, J. L. HILLS (*Vermont Sta. Report for 1892, p. 33*).—Percentages of sugar in 17 samples from different parts of the State.

Four ways of preserving fodder corn, W. W. COOKE and J. L. HILLS (*Vermont Sta. Report for 1892, pp. 163–197*).

Synopsis.—A comparison of ensiling and field curing corn with and without the ears, the ears being ground in the latter cases and fed with the stalks from which they were taken. The loss in keeping was nearly the same for the four methods. Each kind of fodder was fed *ad libitum* to twelve cows with grain and hay. The yields of milk and fat were practically the same, but more of the fodder was eaten when the ears were removed and ground, so that, calculated on the basis of one acre of corn, the whole silage gave the largest yield of products. The results were lower in each case where the ears were removed, ground, and fed with the stalks than when ensiled or field-cured with the stalks. The silage and corn fodder were alike in their effect on the composition of the milk.

This experiment is a repetition on a more extensive scale of one reported in the Annual Report of the station for 1891 (E. S. R., vol. IV, p. 481). In 1892 the corn at the station (a mixture of Sanford and

Red Cob) was harvested and treated in the following manner: That from the first two rows was cut up, ears and all, into quarter-inch pieces and ensiled; that from the next two rows was cut and ensiled, the ears being previously picked off; that from the next two rows was stooked near the barn and when wanted for feeding was cut up as for silage, ears and all; and that from the next two rows was stooked near the barn, the ears picked off and ground, cobs and all, and the stalks cut up for feeding. The corn picked off and ground was fed with the ensiled corn and corn fodder to which it belonged. This plan was followed out through the entire field. The crop was thus divided into four equal parts, two parts of which were ensiled and the other two parts field-cured, the ears from one part in each case being cut up and fed, and from the other part ground and fed with the respective corn fodder or silage. The corn fodder stooked out of doors kept well through the winter, and that fed the last of March was in excellent condition, presenting no signs of heating or molding. The percentage of the dry matter, albuminoids, and carbohydrates in the crop which was lost in keeping is shown in the following table:

Loss of material from harvesting to feeding.

Method of preservation.	Dry matter.	Albuminoids.	Starch, sugar, etc.
	Per cent.	*Per cent.*	*Per cent.*
Stalks and ears ensiled together	18	11	27
Stalks ensiled alone	21	14	29
Field-cured corn fodder, fed all together	18	9	27
Field-cured corn stover, ears picked off and ground	17	9	23
Average	18	11	24

"The results show that notwithstanding the very different treatment given to the several portions, the losses are not only about the same in degree, but also much the same in kind."

Remarks are made on the relative losses of water, dry matter, and food constituents by the four ways of keeping; on the relation of losses in ensiling to the rapidity of feeding; and on the weight of silage per cubic foot.

The feeding experiment was made with four lots of three cows each, each lot being fed for a period of four weeks on each of the particular kinds of corn fodder and silage. In a fifth period each lot was brought back to the food given it in the first period. The corn fodder and silage were fed *ad libitum*. In addition each cow received 3 pounds of wheat bran, 2 pounds of corn meal, and 10 pounds of clover rowen per day. The feeding trial lasted from November 9 to March 29. The total yields of milk and milk constituents on the several kinds of coarse fodder were as follows:

Yield of milk, etc., on silage and corn fodder.

Kind of fodder.	Milk.	Total solids.	Fat.	Solids-not-fat.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
Ensiled stalks and ears	4,877	647	199	448
Ensiled stalks and ground ears from the same	4,714	625	194	431
Field-cured corn fodder, stalks, and ears	4,724	632	197	435
Field-cured corn stover and ground ears from same	4,860	648	199	449
Average	4,794	638	197	441

These results will probably be a surprise to many who would expect to see the silage surpass the stooked fodder, and a still greater surprise to the larger number who would expect decidedly better returns where the corn was husked and ground than where it was fed whole on the ear or put whole into the silo.

There is essentially the same return in milk and its products from the four methods of handling the corn crop. The difference between the best and the poorest amounts to 3.3 per cent, or one thirtieth of the total yield.

The results may be fairly interpreted to mean that all four ways of handling the corn crop preserve it in good, palatable condition, and if the cows are allowed to eat all they want they will give about the same returns during the same number of days' feeding from each method.

The tables of composition of the milk indicate that "the four methods of handling the crop produced no effect on the quality of the milk." As to the amount of dry matter eaten in the various rations, this was least on whole silage (5,948 pounds), and greatest on stover and ground ears (6,624 pounds). Almost exactly 6 acres of corn were harvested. The yield of milk and milk constituents from the corn from one acre when fed as in this experiment is calculated as follows:

Yield of milk, etc., per acre of corn.

Method of preservation.	Milk.	Total solids.	Fat.	Solids-not-fat.	Equivalent of butter.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Ensiled stalks and ears	8,113	1,067	333	735	398
Ensiled stalks and ground ears from the same	6,399	849	264	585	317
Field-cured corn fodder, stalks, and ears	7,188	961	300	661	360
Field-cured corn stover and ground ears from same	6,420	856	263	593	316

The above represents the yield of the corn crop from one acre when it is fed under the conditions of the experiment and with its accompanying amount of hay and grain. But as this additional or non-experimental hay and grain would be in different quantities for the different methods, the figures do not represent a strict comparison of the results from the four methods. It would be strictly and exactly correct to say that the crop from one acre, when preserved as whole silage and fed with 4,313 pounds of clover rowen and 2,157 pounds of grain, produced 8,113 pounds of milk, 1,067 pounds of total solids, and 398 pounds of butter. It would take the yield from 1.26 acres preserved as stover silage [ears picked off] or as corn stover [and ground ears], or the yield from 1.08 acres preserved as whole corn fodder with the same amount of hay and grain to produce an equal amount of milk and milk products.

The gain in quantity of milk from whole silage over whole corn fodder is nearly the same as was found in the extended experiment on the same point conducted by the station two years ago and already reported [Report for 1891; E. S. R., vol. IV, p. 481].

The gain in fat this time is somewhat greater than before, being 8 per cent as against 3 per cent two years ago.

Both the stover silage and the corn stover [ears removed and ground] show decidedly poor returns as compared with whole stooked fodder, and still more so when compared with whole ensilage. To explain this it will be necessary to consider more in detail the methods of handling the crop and the effects of these methods.

However the result is calculated, the conclusion is that picking the ears off and husking and grinding them was not a judicious practice. The returns in milk and butter were not as large where this was done before ensiling or field-curing as where the ears were left on. As more dry matter was eaten by the cows when the ears were removed and ground in the case of both silage and corn fodder, the authors conclude "that the dry matter in the ears and husks that had been dried and ground was of less value, *i. e., less digestible*, than that in the ears and husks of the whole silage. This is the same as saying that the drying and grinding *decreased the digestibility* of the corn meal."

"Leaving out of account the bad effects of the drying and grinding, there is still a complete loss of all the labor and expense of the extra work," which is calculated to be about 16 cents per bushel of corn, or more than one fourth the value of the meal at $20 per ton.

In addition to the data already cited, an appendix contains full tabulated data for the experiment, including average analyses of the crops as harvested and as fed, the losses of food ingredients in keeping, and the individual records of the twelve cows.

The results and inferences of this experiment are summarized by the authors as follows. They use the terms whole silage and whole corn fodder to mean the whole corn, ears and all, either ensiled or field-cured with the stalks, and the terms "stover silage" and corn stover to mean the stalks ensiled or field-cured alone and fed with the ground ears.

(1) All four methods produced a good fodder, well preserved and relished by the cows.

(2) The whole silage, the corn fodder, and the corn stover saved about the same amount of dry matter ready for feeding; the stover silage saved 3 per cent less than the other; the average of all was 82 per cent saved, 18 per cent lost.

(3) There was no great difference in the amount of milk or butter produced by the different methods. The difference between the best, the whole silage, and the poorest, the stover silage, was about 3 per cent. The average of the two silages was the same as that of the two stooked fodders. The same is true of the average of the two stovers as compared with that of the two whole fodders.

(4) The four methods of handling the crop produced no effect on the quality of the milk.

(5) The cows ate very different quantities of dry matter when on the different portions to produce equal quantities of milk and butter.

(6) For each 100 pounds of dry matter of the whole silage eaten, the cows ate 119 pounds of dry matter in the stover silage, 109 pounds from the corn fodder, and 127 pounds of dry matter from the corn stover.

(7) If all of each fodder had been fed out under the conditions of the experimental periods, with corresponding amounts of rowen and grain, the stover silage would have produced 82 pounds of milk for each 100 pounds produced by the whole silage. The corn fodder would have produced 92 pounds and the corn stover 82 pounds. The proportions are much the same with regard to the yield of butter.

(8) One acre of the corn crop preserved as whole silage and fed with 4,313 pounds of clover rowen and 2,157 pounds of grain, produced 8,113 pounds of milk, 1,067 pounds of total solids, and 398 pounds of butter.

(9) The whole silage lasted the longest every time. Consequently it would take less of it to last a herd for a given time. One acre of corn made into whole silage yielded as much return in milk and butter as 1.26 acres made into stover silage, or 1.08 acres made into corn fodder, or 1.26 acres handled as corn stover.

(10) The drying and grinding of the ears of the stover silage and corn stover seem to have made them less digestible, and this is the reason why these portions have done so much poorer than the whole silage.

(11) Husking, shelling, and grinding the corn to make a bushel of meal costs in this State 16 cents, or more than a quarter of the market value of the meal.

(12) This labor and expense is more than wasted, since the cows did better on the whole corn than on the ground.

(13) Dry corn fodder after being brought into the barn is still undergoing fermentation and loss even when no heating can be detected. In the course of ten days this loss may easily be half as much as took place in the stook. These changes and losses take place less rapidly in cold weather than in warm.

(14) The losses of dry matter and feeding value in silage are closely proportional to the losses in weight.

(15) The silage at the time of usual opening of the silo has in it still nearly all the feeding value that it had when put into the silo.

(16) The large losses of feeding value that occur in the silo are almost entirely at the time of feeding out the silage.

(17) These losses can be largely prevented by using small, deep silos that will allow the feeding of 2 to 3 inches from the surface daily.

(18) This is especially true of silage to be used in place of a soiling crop in summer.

(19) The silage in the lower portions of a silo is not so compressed and solid at the time of feeding as would be expected from its weight at the time the silo was filled.

Relative value of corn silage and fresh corn fodder, W. W. COOKE (*Vermont Sta. Report for 1892, pp. 154, 155*).—Eleven cows fed freshly cut corn fodder shrunk about 5 per cent in butter yield in two weeks, while nine cows fed at the same time on corn silage from the previous year's crop gained about 8 per cent in butter yield. The silage was made from corn which had a larger proportion of ears than that fed green in this trial. No data are given.

Oat feed, W. W. COOKE (*Vermont Sta. Report for 1892, pp. 153 154*).—The results of a comparison of this refuse from oatmeal mills with a mixture of corn meal and wheat bran for cows "indicates for the oat feed a feeding value just about equal to the mixture of equal parts by weight of bran and corn meal. * * * From its chemical composition oat feed would seem to be not much different from a mixture of equal parts by weight of wheat bran and corn meal." Analyses of oat feed, corn meal, wheat bran, and the mixture of bran and corn meal are given.

Feeding tests with by-products of corn, W. W. COOKE (*Vermont Sta. Report for 1892, pp. 143–153*).—This is a more detailed account of a feeding test of cream gluten meal, corn germ feed, and Buffalo gluten meal, for cows, reported in Bulletin No. 31 of the station (E. S. R., vol. v, p. 73).

Change from barn to pasture, W. W. COOKE (*Vermont Sta. Report for 1892, pp. 155, 156*).—The record is given for a herd of 15 cows when changed from barn feeding to pasture.

Before going to pasture these cows were fed grain, hay, and silage in abundance at the barn, and the feeding was continued in liberal allowance after the cows were turned out, the cows standing in the barn every night. * * * The cows, as a whole, gained in everything, quantity of milk, quality of milk, and quantity of butter fat. Out of the 15 cows, 12 gained in quantity of milk, 13 gained in quality, and 13 gained in quantity of fat. The total average gain was a little over a pound and a half of milk daily for each cow, or about one twelfth of the whole yield; about a fifth of 1 per cent gain in the quality of the milk and a tenth of a pound of butter fat more daily, equivalent to one seventh of the whole yield. In other words, the cows on pasture made as much butter in seven days as they had been yielding at the barn in eight days.

Roots vs. silage for milk production, W. P. BROOKS (*Massachusetts Hatch Sta. Report for 1892, p. 153*).—A daily ration of 30 pounds of silage from Longfellow corn, generally well glazed when cut, was compared with 40 pounds of sliced beets for milk production, feeding the same amounts of hay, stover, and mixed grain with each. Four new milch cows were used, and each of the four periods of the test was three weeks.

The cows gave more milk and more cream when receiving silage, and gained weight, while they lost weight when receiving the beets. The figures for the four cows during eight weeks (the last two weeks only of each of the three-weeks' periods being taken into account) are as follows: For beets: milk, 2,787 pounds; cream, 840 spaces; for silage: milk, 2,908 pounds; cream, 849 spaces.

Pig feeding, W. W. COOKE (*Vermont Sta. Report for 1892, pp. 44–55*).

Synopsis.—A comparison of feeding sweet and sour skim milk, of feeding 2 ounces and 4 ounces of corn meal per 100 pounds of skim milk, and of increasing the amount of skim milk during finishing off. Sour skim milk gave generally as good results, pound for pound, as sweet skim milk. Two ounces of corn meal per pound of skim milk gave cheaper pork than 4 ounces. During finishing off, 12 pints of skim milk, with its complement of corn meal, gave a larger and cheaper gain than 6 pints of skim milk.

This experiment was with 8 pigs about eight weeks old at the beginning, and lasted from May 23 to November 11. These were divided as equally as possible into four lots. Two lots had sweet skim milk and the other two lots sour skim milk, the object being to determine whether there was any disadvantage from creamery skim milk becoming sour before feeding. One lot in each case had 2 ounces of corn meal per quart of skim milk, and one lot 4 ounces. The experiment thus enabled a comparison of sweet and sour milk, and of different quantities of corn meal.

In every case the pigs were fed all the skim milk they would eat until they were taking 6 quarts each daily. This amount was then kept constant and whatever more the pig could be induced to eat was made up of wheat bran and corn meal in varying proportions. * * * During the finishing-off process, part of the pigs kept the same amount of skim milk, 6 quarts daily, that they had previously; the rest were given 12 quarts each daily.

The corn meal was in every case mixed with the skim milk just before feeding. Data for the experiment are tabulated and discussed. The principal results are given below.

Sweet skim milk vs. sour skim milk.—From May 23 to October 13, the pigs on sweet skim milk gained 172, 177, 179, and 187 pounds, respectively, or a total of 715 pounds for the two lots; and the pigs on sour skim milk gained 171, 173, 166, and 178 pounds, respectively, or a total of 688 pounds for the two lots. In each case the pig on sweet skim milk gained slightly more than its mate on sour skim milk, the total difference in favor of sweet milk being 27 pounds. During the finishing-off process, from October 13 to November 11, the pigs on sweet skim milk gained 77, 65, 55, and 43 pounds, respectively, or a total of 240 pounds; and the pigs on sour skim milk gained 82, 72, 70, and 51 pounds, respectively, or a total of 275 pounds, and a gain over the lot on sweet milk of 35 pounds. Hence during the entire feeding the pigs on sweet milk gained 955 pounds and those on sour milk 963 pounds. At slaughtering it was found that the pigs on sweet skim milk shrunk, on an average, 18 per cent, while the pigs on sour milk shrunk only 14 per cent. No explanation is offered for this difference.

The above results, taken in connection with those obtained in a similar experiment reported in the Annual Report of the station for 1891 (E. S. R., vol. IV, p. 484), indicate that sour skim milk is at least equal in feeding value for pigs to sweet skim milk.

Heavy vs. light feeding of corn meal.—The pigs receiving 4 ounces of corn meal per pound of skim milk made a larger gain than those receiving only half as much corn meal, but the difference was not sufficient to offset the extra amount of food. "The former gained 28 pounds more in weight and consumed 212 pounds more of grain; thus the extra gain would not half pay for the extra feed."

During the finishing-off period the pigs which had had the smallest ration of corn meal gained 284 pounds, while those which had had the larger ration gained only 231 pounds. "The experiment shows then that the pigs gave better returns when fed 2 ounces of corn meal to each quart of skim milk, than when given 4 ounces of meal to each quart of milk."

Proper amount of skim milk for finishing off.—As mentioned above, during the finishing-off period, 4 of the pigs were kept at 6 quarts of skim milk per day, and 4 were increased to 12 quarts. The pigs on the larger allowance of skim milk gained the most and required one tenth less food per pound of gain. With skim milk at 15 cents per 100 pounds and corn meal at $22 per ton, the feeding of the larger ration was the most profitable.

Remarks are also made on shrinkage in dressing, weight at which pigs should be sold, financial results, value of skim milk, and fertilizing value of feeding stuffs.

VETERINARY SCIENCE AND PRACTICE.

J. F. DUGGAR, *Editor.*

Loco and larkspur poisoning, D. O'BRINE (*Colorado Sta. Bul. No. 25, Oct., 1893, pp. 26, figs. 11*).—This bulletin is a progress report on the author's investigations on the subject of loco and larkspur poisoning. The bibliography of loco is quite extensively reviewed and quoted. Details are given of several post-mortem examinations, which showed various diseased conditions. Figures are given of the more common loco weeds as follows: *Astragalus mollissimus, A. drummondii, A. sericoleucus, A. caryocarpus, A. bisulcatus, Oxytropus lamberti,* and *Sophora sericea.* Chemical analyses are given of *Astragalus mexicanus, A. mollissimus, A. caryocarpus, A. drummondii, Oxytropus lamberti, O. monticola,* and larkspur (*Delphinium* sp). In conclusion the author says:

We have been unable to find any alkaloid in the plants examined, though we get alkaloidal reactions from the loco.

We have not been able to produce any physiological action upon rabbits with the extract from the loco in any of its forms. In the case of the sheep in the southern part of the State, said to have been locoed, it has long been known that the disease is caused by parasites in the liver.

The post-mortems made showed such a variety of diseased conditions that, in our judgment, they could hardly be due to one and the same cause.

It has always been noticed that when the feed on the range is good, locoed animals are scarce. The range about Fort Collins contains the loco in large quantities, but I have never seen a locoed animal except upon the mountain range or foothills.

In our experience the animals affected, and the subjects for post-mortems, were, in every case, young animals, mostly under four years old, the great majority yearlings and two-year olds.

I have long been persuaded that the person who investigates the subject of loco should spend considerable of his time on the range and notice very carefully the habits of the animals, the food they eat, and the water they drink. The subject has not been investigated to the extent that its importance demands.

It is never wise to draw hasty conclusions from imperfect data, or from a few post-mortems. Judgment had better be withheld until the subject is more thoroughly investigated.

DAIRYING.

E. W. ALLEN, *Editor.*

Relative value of a cow for cheese-making and for butter-making, W. W. COOKE (*Vermont Sta. Report for 1892, pp. 122, 123*).—An estimate of the probable yield of cheese by various Jersey, Holstein, and Ayrshire cows of the station herd on the basis of the yields obtained in experiments at the New York State Station leads the author to the conclusion that "the so-called 'cheese-cow,' *i. e.*, the cow which is good especially for cheese rather than for butter, does not exist, and that wherever a cow is found that is good for cheese-making purposes the milk of that cow is equally good for the manufacture of butter."

Record for the station herd for the year 1892, W. W. COOKE (*Vermont Sta. Report for 1892, pp. 119–121*).—The record is tabulated for 21 cows of the station herd for the year 1892 showing for each cow the total milk yield, average per cent of fat in milk, the calculated total yield of butter, and the average amount of milk required to make 1 pound of butter. The average per cow for the whole herd was 7,028 pounds of milk containing 4.32 per cent of fat, from which 334 pounds (calculated) of butter were made, or 1 pound for each 21.1 pounds of milk.

Variations in quantity and quality of milk, W. W. COOKE (*Vermont Sta. Report for 1892, pp. 89–119*).

Synopsis.—A résumé of the data collected at the station during several years regarding the following points: The changes in milk during the entire milking period, during the first few weeks after calving, from year to year, and from one calving to the next; the effect of breeding, of abortion, of grain feeding, and of summer and winter food on milk; and the time and frequency of testing the milk of cows.

For a number of years the station has kept individual records of the cows of its herd, including frequent analyses of the milk. Portions of the data thus secured are tabulated and discussed. On this basis the author makes the following deductions concerning various changes in the character and amount of the milk and the effect of certain factors in this connection.

(1) All cows shrink in quantity of milk as they get farther from calving. If they are farrow, this shrinkage in quantity is accompanied by almost no change in quality, even until they go dry, provided they are still farrow. If they are in calf the milk increases in quality as it decreases in quantity; this increase is slight, only one twentieth during the first six months after calving, but becomes quite pronounced just before the cow goes dry.

(2) Cows that calve in the spring average more milk during the first three months after calving than those that calve in the fall. For the seventh, eighth, and ninth months this is reversed. Fall cows show smaller variations in the quality of the milk than cows that calve in the spring.

(3) The milk of a cow for the first few days or weeks after calving is very variable in quality. On the average it is thinnest just after calving, becomes slightly richer during the next two weeks and then holds almost uniform in quality for the next four or five months.

(4) Cows vary in the quality of their milk from one milking to the next, and from day to day, the quality rising and falling without apparent cause. Such changes are usually within 1 per cent of fat, but one cow was known to change 2.68 per cent in two days. The least change of any of the cows in the station herd during an entire period of lactation is 0.33 per cent fat, the average change 1.34 per cent, and the greatest change 2.78 per cent. The largest variation in yield of butter is from milk that required 20 pounds of milk to make a pound of butter, to a quality of milk which would require but 11.7 pounds. It is probably possible that cases may occur of a doubling in the richness of the milk during different times in the same period of lactation.

(5) Just after calving the milk is poorer in fat, and in solids not fat, than just before the cow goes dry. The average drop in fat is 1.13 per cent, the greatest change being 2.35 per cent, and the least 0.49 per cent. The average change in solids-not-fat is a fall of 4.47 per cent, with variations from a decrease of 1.94 per cent to an increase of 0.42 per cent.

(6) Most cows give about the same quality of milk year after year, beginning with this quality at the first calving. There is no general tendency for the milk to become either richer or poorer as the cow grows older.

(7) From one calving to the next, cows may be expected to vary the general quality of their milk not much more than a sixth of 1 per cent of fat, and scarcely ever will show a variation of more than a quarter of 1 per cent.

(8) The milk of a heifer tends to agree very closely in quality with that of her dam; the average variation is a third of 1 per cent of fat and the greatest difference is 1 per cent in the case of an Ayrshire cow crossed with a Jersey bull.

(9) The present cheap, rapid, and easy methods of testing cows, leave no excuse for any dairyman's not knowing the quality of the milk of each one of his cows. If two tests are made, each of a mixed sample of four days' milk, one being taken six weeks after the cow calves and the other six months after calving, the average of these two tests will agree almost exactly with the average quality of the milk given during the entire milking period. There will seldom be a difference of as much as a quarter of 1 per cent of fat.

(10) If it is desired to know from tests nearer together what quality of milk a cow gives, very accurate results will be obtained by making two tests fifteen days apart four months after the cow calved, each test being on a mixed sample of four days' milk. The average of these two tests with one eighth of 1 per cent of fat added, is surprisingly near the truth for the average quality of the year's milk.

(11) In the long run, just the same results are obtained whether cows are tested once a month or twice a month.

(12) Cows that have been properly fed at the barn do not shrink in quality of milk when turned to pasture. They usually increase both in quality and quantity.

(13) Full feeding with grain at the barn and while the cows are on pasture produces a much larger flow of milk during April and May, and causes the milk flow to keep up considerably later in the fall. No attempt was made to ascertain whether this increase was sufficient to pay for the extra grain.

(14) The milk produced by the cows of Vermont during the entire year contains on the average 4.11 per cent of fat and would, if rightly handled, make a pound of butter from each 22 pounds of milk.

(15) The station herd was troubled with abortion and the trouble ceased after thorough disinfecting with sulphur and a plentiful use of laudanum. There is nothing to prove conclusively that the treatment was the cause of the cessation of the disease.

(16) The most noticeable effect of abortion on the quality of the milk is to make it richer than it would have been had the cow gone full time. This quality, however, falls during the first few months after abortion, until by the third or fourth month it is of about the same quality as would have been given if the cow had calved naturally.

(17) The worst effect of abortion is the decreased quantity of milk given, which, with the cows at the station, amounted to about one third of the full yield.

Abnormal milks, J. L. HILLS (*Vermont Sta. Report for 1892, p. 128*).—A registered Holstein and a registered Ayrshire cow gave milk of the following composition just before going dry:

Composition of abnormal milks.

	Total solids.	Fat.	Solids-not-fat.	Specific gravity.
	Per cent.	*Per cent.*	*Per cent.*	
Holstein	17.08	5.90	11.18	1.040
Ayrshire	10.33	2.98	7.35	1.027

At the time the samples were taken they were giving 3.6 and 5.5 pounds of milk per day, respectively. A sample of liquid (milk?) taken after slaughtering from the udder of a three-year-old heifer which had never calved contained 9.13 per cent of solids, 1.2 per cent of fat, 5.58 per cent of casein, and 2.35 per cent of milk sugar and ash.

The effect of weather upon the quantity and quality of milk, J. L. Hills (*Vermont Sta. Report for 1892, pp. 128–136*).—An investigation similar to that reported in the Annual Report of the station for 1891 (E. S. R., vol. IV, p. 491) was made in 1892. The results point in the same direction as those obtained the previous year. They indicate that when cows were at pasture the quality of the milk varied with the temperature, becoming richer as the temperature fell and poorer as it became warmer. The same variations were found to be true of the total solids and of the solids-not-fat. Violent changes in temperature tended to diminish the quantity of milk. Rain storms, unless very heavy, appeared to have no noticeable effect on either quantity or quality of milk.

"We have not been able to discover any more plausible theory for this tendency of the cow's nature than the one suggested in this connection in the last report, that 'during cold weather the cow actually consumes more food, and thus there is present in the system a larger amount of material from which to produce richer milk.'"

Aëration of milk, W. W. Cooke (*Vermont Sta. Report for 1892, pp. 123–128*).—The results are reported of seven tests with the Heuling aërator and three with the Wood aërator. In each case the milk from a milking was divided, one half being set at once and the other half aërated. Separate portions were cooled in aërating and others not cooled. As a result of the six trials the statements are made that "aërating milk without cooling has no effect on the creaming of that milk, but if the milk is cooled during the aëration the creaming of the milk will be less perfect. Aërating milk does not make it keep longer before it sours, but cooling milk as soon as drawn from the cow will retard the time of souring."

Tests of dairy apparatus, J. L. Hills (*Vermont Sta. Report for 1892, pp. 136–143*).—This includes a report on tests of the DeLaval Acme belt separator, DeLaval steam turbine separator, Russian steam separator, Imperial Sharpless separator, United States hand separator, and the DeLaval Baby hand separator; a trial of two steam Babcock milk testers, and churning tests. These tests were made in connection with the dairy school. The hand separators did practically as well and in some cases better than the power separators. The DeLaval Acme belt separator, running at 6,400 revolutions per minute, skimmed 1,120 pounds of milk per hour, and the skim milk contained 0.085 per cent of fat. The DeLaval steam turbine separator, running at 6,100 revolutions per minute, skimmed 1,867 pounds of milk, and the percentage of fat in the skim milk was 0.086. The Russian steam separator, dairy size,

running at 7,200 revolutions per minute, skimmed 840 pounds of milk per hour, and the per cent of fat in the skim milk was 0.204. The latter machine warmed the skim milk 2° F. and cooled the cream 2°.

"The cooler temperatures (54°–58° F.) caused less loss of fat in churning, but it took longer to churn. * * * The lower the churning temperature the richer and firmer the butter."

Some new points in the manipulation of the Babcock milk test, E. H. FARRINGTON (*Illinois Sta. Bul. No. 27, Sept., 1893, pp. 245–248*).—As a result of his large experience with the Babcock milk test in the dairy test of the World's Columbian Exposition the author finds that the separation of either black or white flocculent matter with the fat is often due to manipulation rather than to a too weak or two strong acid. For a number of months 150 tests of milk were made daily, representing a great variety of milk. "We have been able to test successfully any milk yet received, and by proper manipulation to get a very clear separation of the fat."

If, in addition to the details worked out by Dr. Babcock, the following precautions are observed, the author is confident that the test will work satisfactorily:

(1) An acid having 1.82 specific gravity should be used with milk at 60° to 70° F. If the acid is stronger, cool the milk to a lower temperature. Somewhat weaker acid can probably be made to work all right by warming the milk.

(2) When measuring the acid into the test bottles hold the bottle at an angle that will cause the acid to follow the inside walls to the bottom of the bottle and not drop through the milk in the center of the bottle. If properly poured into the test bottle there will be a distinct layer of milk and acid, with little or no black color between them.

(3) Thoroughly mix the milk and acid as soon as measured into the test bottle. A better separation of fat is obtained by mixing at once than by allowing the two liquids to stand unmixed in the bottle until enough tests have been measured out to fill the centrifuge.

(4) After five minutes whirling of the test bottles in the centrifuge add hot water until the test bottle is filled up to the neck only; run the centrifuge one minute, then fill the neck of the test bottle with hot water and run the centrifuge another minute. Adding the necessary hot water in two portions is often a great help in getting a clear separation of fat. When the test bottles are taken from the centrifuge they are put into water at 140° to 160° F., and the per cent of fat read at that temperature.

(5) Too low results will be obtained if the centrifuge does not have sufficient speed. The machines have to be watched, as constant use wears some of them so that the speed designed by the manufacturer is not obtained.

(6) When testing skim milk or buttermilk which has a very small per cent of fat (two tenths of 1 per cent or less), the reading of the per cent of fat should be made immediately on taking the test bottle from the centrifuge. If this is not done, and the test bottle cools before taking the reading, the contraction of the liquid in the bottle will often leave the fat spread over the inside surface of the measuring tube, so that it is not seen, but has the appearance of being only a dirty tube. If read when taken from the machine, the small globules of fat can be seen and estimated.

STATION STATISTICS.

Fifth Annual Report of Massachusetts Hatch Station (*Massachusetts Hatch Sta. Report for 1892, pp. 147–166*).—This includes the treasurer's report for the fiscal year ending June 30, 1892, and contributions from the various departments of the station, abstracts of which are given elsewhere in this number of the record.

Biennial Report of Minnesota Station (*Minnesota Sta. Biennial Report for 1891 and 1892, pp. 266, figs. 4*).—This includes brief reports by the director and agriculturist, dairyman, horticulturist, chemist, entomologist, and botanist; a general inventory of the station property; and the text of Bulletins Nos. 19 to 25, inclusive, abstracts of which have already been published.

During the period covered by this report the station has issued thirteen bulletins.

Although the bulletins are issued in editions of 15,000, this number is inadequate to supply our present mailing list, and at the same time furnish copies to be sent to new names which are constantly coming in. * * *

The station farm comprises about 150 acres of land under cultivation, exclusive of pasture. This entire area is used annually in plat experiments and in the production of the fodder and grain for the stock. * * *

To bring the station into more intimate relation with the farmers of the State and to draw the attention and interest of the agricultural communities to our work, the members of the staff have improved their opportunities to address meetings of the farmers whenever invited so to do. Many of the country fairs were visited and practical addresses given. During the summer of 1892 the time of Prof. Haecker was occupied in visiting the creameries to give instruction where needed and to call the attention of the people employed in dairy work to the advantages offered by the school, and to the work done at the station. In this connection I must not fail to record the gratitude of the station staff to the railroads who have shown their kindness to the station and their appreciation of our work by granting free transportation to the director and other members of the staff when called to distant parts of the State on experimental work. This aid has been of invaluable service to the station. * * *

These railroads have also extended their courtesy to the station, by transporting, free of charge, in many cases, both to and from the station, the material used in our coöperative experiments, when conducted by farmers along their respective lines.

Fifth Annual Report of Mississippi Station (*Mississippi Sta. Report for 1892, pp. 3*).—A financial statement for the fiscal year ending June 30, 1892.

Fifth Annual Report of Nevada Station (*Nevada Sta. Report for 1892, pp. 31, plates 2*).—A financial statement for the fiscal year ending June 30, 1892, and a brief report on the work of the year.

Third Annual Report of New Mexico Station (*New Mexico Sta. Report for 1892, pp. 15*).—This includes brief statements on the work and condition of the station, and a financial report for the fiscal year ending June 30, 1892.

Fifteenth Annual Report of North Carolina Station (*North Carolina Sta. Report for 1892, pp. 42*).—This contains a general review of the work of the year, a list of bulletins published, a financial statement for the fiscal year ending June 30, 1892, a digest of fertilizer laws of the State, remarks on the fertilizer control, the coöperative station exhibit at Chicago, grass culture in coöperation with this department, cultivation of American tea, weather forecasts, climatology of the State, and brief reports by the heads of the several divisions of the station.

Report of director of Vermont Station (*Vermont Sta. Report for 1892, pp. 9–29*).—A brief survey of the work of the year and the results obtained, a list of the bulletins published by the station, and abstracts of Bulletins Nos. 28 and 29 (E. S. R., vol. III, p. 892; IV, p. 133).

Report of treasurer of Vermont Station (*Vermont Sta. Report for 1892, p. 9*).—A financial statement for the fiscal year ending June 30, 1892.

Second Annual Report of Wyoming Station (*Wyoming Sta. Report for 1892, pp. 204, figs. 6*).—This includes the reports of the director, treasurer (for the fiscal year ending June 30, 1892), horticulturist and meteorologist, geologist, botanist, entomologist, chemist, and the superintendents of the experiment farms at Laramie, Lander, Saratoga, Sheridan, Sundance, and Wheatland, all of which are brief outlines of the work of the year. Bulletins Nos. 5 to 10, inclusive, abstracts of which have already been given, are reprinted in full.

ABSTRACTS OF PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE.

Indian corn in the manufacture of beer, R. WAHL (*pp. 21*).—This publication advocates the use of corn in the manufacture of beer. The following subjects are treated: Replacement of barley malt by other materials; valuable properties of beer; precautions necessary to insure stability of beer; the bottle-beer industry; the instability of malt beers; methods of mashing; the use of wheat, oats, rice, and corn as brewing materials; effect of corn oil on the quality of beer; the preparation of brewers' grits and brewers' meal, and the management of these in the manufacture of beer; influence of the mashing method; and a comparison of American with foreign beers.

The kind of corn used for the production of brewers' grits is the variety known as the white flint corn, which at the present time is cultivated on a large scale in several States of the Union, more particularly in Indiana, Illinois, and Nebraska, exclusively for such mills as make a specialty of brewers' grits.

Products from flint corn have a better appearance and contain less oil than those made of red or mixed corn. The quality of the product improves as the ratio of oil decreases. The greater the amount of oil, the greater also the amount of neutral bodies, such as cellulose and albuminoids, and the less the amount of the valuable substances—that is, starch. The percentage of oil can thus be looked upon as an indicator of the value of a corn product for brewers, more particularly if the percentage of water, which is independent of the oil, be known. * * *

A product containing over 2.5 per cent of oil should not be used for brewing under any circumstances. * * *

The permissible limit for water in the corn product has for a long time been placed at 13 per cent. The less water, the greater the ratio of starch and the better will the product keep if stored for any length of time. * * * By a proper selection of the method of mashing, we are enabled to produce beers whose composition agrees with the English beers on the one hand and with the German beers on the other hand. There is, therefore, no plausible reason why corn should not be used in England and Germany as well as in the United States. Moreover, corn is cheaper, pound for pound, than either barley malt, sugar, or rice, while it yields as much extract as rice or grape sugar, and much more than barley malt.

Contributions from the U. S. National Herbarium (*Division of Botany, Contributions from the U. S. National Herbarium, vol. I, No. 8, Oct. 31, 1893, pp. 265–292, plates 5*).—A miscellaneous bulletin containing the following articles: (1) Notes on some Pacific coast grasses, George Vasey; (2) descriptions of new or noteworthy grasses from the United

States, George Vasey; (3) descriptions of new grasses from Mexico, George Vasey; (4) descriptions of new plants from Texas and Colorado, J. M. Holtzinger; (5) list of plants new to Florida, J. M. Holtzinger; (6) descriptions of three new plants, J. N. Rose; and (7) list of lichens from California and Mexico, collected by Edward Palmer from 1888 to 1892, J. W. Eckfeldt.

Insect Life (*Division of Entomology, Insect Life, vol. V, No. 5, July, 1893, pp. 289–401, plates 2, figs. 10*).—This number contains the following articles:

The present year's appearances of the periodical cicada (pp. 298–300).—An article giving a full list of the localities in which broods XVI and XI of the periodical cicada were expected to appear during the present year and a request for notes of verification and additions from correspondents.

Further notes on yucca insects and yucca pollination, C. V. Riley (pp. 300–310).—A full account of the life-history of *Pronuba maculata* and its relations with *Yucca whipplei.* Statement concerning *Pronuba yuccasella* on the Pacific coast, where it fertilizes *Yucca baccata*, *Y. rupicola* and *Y. elata;* some account of *Pronuba synthetica* and its habits in connection with *Yucca brevifolia;* brief notes concerning *Prodoxus coloradensis*, *P. reticulatus*, *P. cinereus*, *P. intermedius*, and *P. intricatus.*

The pollination of Yucca whipplei in California, D. W. Coquillett, (pp. 311–314).—An account of observations upon *Pronuba maculata* and its relations to the flower and fruit of *Yucca whipplei*, together with a list of the insects observed among the flowers of this yucca.

The cocoanut and guava mealy-wing (pp. 314–317).—An account of the life history of *Aleurodicus cocois*, a mealy-wing which occurs upon the cocoanut and guava in the West Indies and which is liable to be introduced into the growing guava plantations of Florida. The species is figured in all of its stages, and descriptions, hitherto unpublished, are given.

Further notes on the cottontail bot, with the breeding and identification of the fly, C. H. T. Townsend (pp. 317–320).—The adult of the cottontail bot has been reared by the author and determined as *Cuterebra fontanella.* A full description is given.

The sugar-beet webworm (pp. 320–322).—Observations upon *Loxostege sticticalis*, supplementary to those published in the Annual Report of the Secretary of Agriculture for 1892. Experiments made at the sugar-beet station of the Department of Agriculture at Schuyler, Nebraska, show that the late fall harrowing brings the cocoons to the surface of the ground, where they are largely emptied by birds.

Report of a trip to northwestern Missouri to investigate grasshopper injuries, Herbert Osborn (pp. 323–325).

The Angoumois grain moth, or fly weevil, L. O. Howard (pp. 325–328).—A brief summary of the life history and habits of the insect, with full directions for the use of bisulphide of carbon and some statement as to other remedies.

Descriptions of Noctuidae from the Death Valley, J. B. Smith (pp. 328–334).—The following new species are included: *Peridroma demutabilis, Scotogramma densa, Oncocnemis flagrantis, Schinia ligeæ, Schinia intrabilis, Tristyla* n. gen., *T. alboplagiata, Omia nesaea, Pleonectyptera finitima*, and *Antaplaga koebelei* Riley.

The red-legged flea beetle (pp. 334–342).—An account of a peculiar case in which *Crepidodera rufipes* appeared in great numbers in a young orchard in Virginia and completely destroyed all the buds and blossoms. Investigation showed that the orchard had just been planted upon land from which black locust scrub had just been removed. The beetles feed preferably upon black locust and were hibernating at or near the surface of the ground when disturbed by the spring plowing.

General notes (pp. 351–367).—Among the subjects of economic importance treated are the following: The cherry-tree tortrix; ravages of bookworms; bee stings and rheumatism; *Heliothis armiger* in Australia; cutworm damage to grapes in California; a banana borer in Trinidad; southern range of the Colorado potato beetle; the spotted bean beetle; the palm weevil in British Honduras; alum for rose chafers; carbon bisulphide for hen lice; and borers in fig trees.

An index and table of contents for volume V (pp. 369–401 and iii–vii) concludes the number.

Catalogue of the exhibit of economic entomology at the World's Columbian Exposition.—C. V. RILEY (*Division of Entomology, Bul. No. 31, pp. 121*).—A catalogue descriptive of the material exhibited by the Division of Entomology at the World's Columbian Exposition. The exhibit was classified as follows: (1) Insects injurious to agriculture; (2) systematic and biologic entomology; (3) silk insects; (4) professional exhibit; (5) insecticides; (6) insecticide apparatus; (7) official publications of the United States Entomologist, and (8) illustrations, maps, and charts. The number of exhibits was 1,032, together with a list of 37 reports and other publications, and 129 plates, figures, charts, and maps.

Proceedings of the Convention of the National League for Good Roads (*Office of Experiment Stations, Bul. No. 14, pp. 101*).—This is a record of the proceedings of the convention held at Washington, D. C., January 17 and 18, 1893, and a hearing by the Committee on Agriculture of the House of Representatives, January 19, 1893.

Report of the statistician (*Division of Statistics, Report No. 109, n. ser., October, 1893, pp. 373–414*).—This consists of the final report on the condition of corn, cotton, potatoes, buckwheat, tobacco, and sugar cane; a statement of the yield per acre of wheat, rye, oats, and barley; reports from United States consular officers on the production of foreign countries; the production, commerce, and consumption of wine in Italy; the citrus fruit crop of Italy; a statement of the amounts of hay imported into the United Kingdom compared with the previous year; an article on corn as feed for horses in Germany, and transportation rates.

ABSTRACTS OF REPORTS OF FOREIGN INVESTIGATIONS.

Invertase in bananas, F. MIERAU (*Chem. Ztg., 17 (1893), No. 71, p. 1283*).—In a previous paper (abstracted in E. S. R., vol. v, p. 223) the author reported finding a ferment in ripe bananas which he called invertase, which inverted cane sugar and thus interfered with the determination of sugar in bananas. The present paper is in continuation of these studies. The sugar was determined by means of a polariscope, while in the previous studies it was determined by Fehling's solution. The presence of a ferment was very apparent where it was not destroyed by heating. Wherever the ferment was destroyed the extract was dextro-rotary, on account of the high cane-sugar content, but where the conditions were favorable for the action of the ferment it was lævulo-rotary, as a result of the inversion of the whole, or nearly the whole, of the cane sugar. Solutions of common cane sugar were inverted with a little banana pulp. These results fully confirm those of the previous paper based on gravimetric analysis.—E. W. A.

Concerning the conservation of manure, R. HEINRICH (*Deut. landw. Presse, 20 (1893), No. 79, p. 825*).—Under the auspices of the Mecklenburg Patriotic Association the author has been carrying on a series of experiments to determine the relative value of various preservatives for manure.

Many questions have arisen during these investigations which demand further study and repeated experiments, but a few of the conclusions reached are stated in the present article.

The experiments from which these conclusions were drawn extended over a period of two and one fourth years. The manure used was the solid and liquid excrement of two cows during two days (70.3 kg. of dung and 24.8 kg. of urine) mixed with 10 kg. of straw cut into 1-centimeter lengths. The preservatives employed on separate portions of this manure were sulphuric acid and phosphoric acid in amounts equal to 0.15 per cent of the whole; kainit, gypsum, and superphosphate-gypsum (containing 8.5 per cent of total phosphoric acid, 6 per cent of free phosphoric acid, 1 per cent of phosphoric acid in the form of mono-calcium phosphate, and 70 per cent of gypsum), each in amounts equal to 3 per cent; mono-calcium phosphate, dicalcium phosphate, tricalcium phosphate, and superphosphate, each in amounts furnishing 0.15 per cent of phosphoric acid; and peat equal to the whole and to half the amount of straw. One portion of the manure was untreated.

Four times during the experiment the different lots were examined with regard to dry substance, total nitrogen, and ammoniacal nitrogen. The data are given in tables, and lead to the following conclusions: (1) Gypsum was a very effective preservative for manure; (2) superphosphate-gypsum gave no better results than gypsum; and (3) monocalcium and dicalcium phosphates were but slightly effective as preservatives.

Of the other preservatives used kainit gave good results, while free sulphuric acid, and phosphoric acids and peat hindered the decomposition of the manure but little.

The special action in arresting fermentation claimed for free phosphoric acid by Holdefleiss and Immendorff* was not observed in these experiments.

It is believed that the discrepancies between results of different experimenters may be partly explained by changes due to variations in the supply of air and thickness and compactness of the mass of manure. To study this point four pairs of four-liter flasks were filled with pure horse dung, one of each pair being loosely filled and the other packed down with the hand. One pair remained without preservative, one received gypsum, another acid potassium sulphate, and the fourth superphosphate-gypsum. The loss of dry substance after seven and a half months was as follows:

Loss of dry substance in loose and compact manure.

	Loose.	Compact.
	Per cent.	*Per cent.*
With preservative	47.6	19.5
Gypsum (5 per cent)	38.5	18.1
Acid potassium sulphate (5 per cent)	38.7	22.9
Superphosphate-gypsum (5 per cent)	35.1	28.2

Other factors entering into this question, such as the concentration of the preservatives, the action of ferments, etc., are mentioned as subjects also requiring further investigation.

From these considerations the author concludes that the question of manure conservation is not at present as clearly understood as its importance to the farmer demands, and that further investigation of the subject is desirable and necessary.—W. H. B.

Grasses—their use and composition, J. FLETCHER and F. T. SHUTT (*Canada Central Experimental Farm Bul. No. 19, Sept., 1893, pp. 36, figs. 8*).—Notes are given on the agricultural value of grasses, with an epitome of a former report (Report of Dairy Commissioner, 1891–'92, p. 102) on fodder constituents. Descriptions are given of 52 species and varieties, both native and introduced, that have been under cultivation for four years or more at the station farm. From Manitoba and

*Jour. Landw., 41 (1893), pp.1-56 (E. S. R., vol. IV, p. 964).

the northwest territories 11 additional species are described and data given regarding their relative value. A chapter is given on the time to cut grasses for hay. Tables giving 92 analyses of grasses, either green, dry, or both, are added to the bulletin—W. H. E.

How many leaves should be left on the tobacco plant? O. PITSCH (*Deut. landw. Presse, 20 (1893), No. 76, pp. 787, 788*).—The author refers to the experiments of F. Haberlandt, in which plants having six leaves gave a larger leaf surface than those with a greater or less number. The thickness of the leaf was increased as the number of leaves decreased from six to one. With plants of seven to twelve leaves the thickness varied but slightly.

Haberlandt also topped and suckered one lot of tobacco plants, simply topped a similar lot, and neither topped nor suckered a third lot, leaving on each plant the same number of leaves. The size of the leaf was greatest when topping and suckering were practiced, about 25 per cent less when the plants were simply topped, and least when neither topping nor suckering was practiced.

In 1889 the author conducted at Wageningen an experiment to ascertain the effect on the size and fineness of the leaves of topping to ten, twelve, and fourteen leaves per plant. The varieties used were Amers and Goundi. The total weights of dried leaves on ten plants topped to ten, twelve, and fourteen leaves were: For Amers, 422.5, 564.1, and 875.9 grams, respectively; and for Goundi, 565.5, 709.8, and 1,006.7 grams, respectively. Not only were the total yields with fourteen leaves the largest, but these plants also gave the largest yield of high-grade tobacco. It is further noticeable that the leaves were as a rule larger and thicker when fourteen leaves remained than when twelve were left.

The size and fineness of leaves were determined as follows: Equal areas of paper were repeatedly weighed, and as these weights showed but slight difference the paper was regarded as of uniform thickness or weight. This paper was then laid on a smooth surface of soft wood, the tobacco leaf spread out and fastened down upon it. The outline of the leaf was traced, and leaf and paper covered by it were weighed. The weight of a square centimeter of paper being known, the area of the paper and of the leaf was easily found, and the fineness of the leaf was calculated by finding the number of square centimeters per gram of weight.—J. F. D.

Experiments with wheat, indigo, cotton, and other crops, B. L. PARSHAD (*Cawnpore Agricultural Experiment Sta. Report for the Kharif and Rabi Seasons, 1891–'92, pp. 31*).—In one of the fertilizer tests on wheat, green hemp and indigo were plowed under as a manure. On other plats gypsum was plowed under with the green hemp and indigo.

The crops of 1891–'92 on these plats were as follows: On the unfertilized plats, 620 pounds of wheat per acre; on the indigo and gypsum plat, 1,367 pounds; on the indigo plat, 1,270 pounds; on the hemp and

gypsum plat, 1,307 pounds, and on the hemp plat, 1,004 pounds. The average results for these fertilizers on the same plats for eight years were as follows: On the unfertilized plat, 1,053 pounds of wheat per acre; on the indigo and gypsum plat, 1,518 pounds; on the indigo plat, 1,544 pounds; on the hemp and indigo plat, 1,280 pounds; and on the hemp plat, 1,206 pounds. It is stated that a green crop of hemp plowed under appears to be the cheapest means of manuring land.

Kainit applied to wheat in connection with a large amount of organic matter appeared injurious in the greater number of cases. Thus in 1891-'92, on one series of plats where the yield without fertilizers was 1,077 pounds of wheat per acre, and where the yield with green hemp plowed under was 1,912 pounds of wheat, the yield was only 1,718 pounds of grain per acre where 300 pounds of kainit per acre was plowed under with the green hemp.

In another series, where 14,600 pounds of stable manure yielded 1,686 pounds of wheat, the addition of 300 pounds of kainit to the manure resulted in a yield of 1,492 pounds; and while 14,600 pounds of woolen refuse resulted in a yield of 2,089 pounds of wheat, this same amount of refuse with 300 pounds of kainit yielded only 1,097 pounds of wheat per acre.

The average results of the preceding three years were but slightly, if at all, unfavorable to kainit.

In a test of varieties, the Indian wheat proved much more prolific than the Australian and Canadian varieties. The foreign varieties yielded from 42 to 1,016 pounds per acre, and the Indian varieties from 498 to 1,334 pounds. Indian varieties of barley proved much superior in yield to Canadian varieties.

Maize was grown continuously on the same plats and with the same fertilizers for eight years. To different plats were applied annually equal quantities of woolen refuse with lime, sheep manure, cow manure, poudrette, and hog manure. Woolen refuse and lime gave the largest average yield of corn, 1,891 pounds per acre, as the average of seven years. Saltpeter did not give any great increase either in the yield of stalks or grain.

Gypsum proved a valuable fertilizer on indigo. In 1891-'92, 200 pounds of gypsum per acre, plowed under at the time of sowing, gave 12,700 pounds of indigo plants per acre; when applied as a top dressing to the indigo plants 6 inches high, the yield was 13,800 pounds. The unfertilized plat yielded only 10,800 pounds. In other years top dressing was the least profitable method of applying gypsum. In each of four years the yield with gypsum, in whatever manner applied, was considerably larger than that on the unfertilized plat.

Cotton was grown continuously on plats fertilized annually with fresh silt from a canal, with kainit and gypsum, with stable manure and gypsum, with stable manure and kainit, and with woolen refuse. The largest yield was on the plat fertilized with woolen refuse.

Cotton planted May 23 was irrigated three times before the rains of

late summer and early fall. Other plats of cotton were planted July 20 and did not require irrigation. The average yield on the early-planted and irrigated cotton was 142 pounds of lint per acre and 341 pounds of seed, against 31 pounds of lint and 64 pounds of seed per acre for the late-planted and non-irrigated plats.

The average of the preceding five years gave 131 pounds of lint and 267 pounds ot seed for the early and irrigated cotton, and 79 pounds of lint and 164 pounds of seed for the late cotton, not irrigated.

Among the other crops on which experiments were conducted were sugar cane, peas, chick pea, potatoes, carrots, mangel-wurzels, turnips, oats, rape, and flax for seed.

The following Indian crops were sown simply to determine the yields: (1) Pulses—lentil, *Lathyrus sativus*, *Cajanus indicus*, *Phaseolus roxburghii*, *P. mungo*, *P. aconitifolius*, cowpea (*Vigna katiang*), and *Cyamopsis psaralioides;* (2) oil-producing plants—castor, *Brassica juncea*, *Eruca sativa*, and sesame; (3) fiber plants—*Crotalaria juncea* and *Hibiscus cannabinus;* (4) cereals—sorghum, *Pennisetum typhoideum*, *Eleusine coracana*, *Paspalum scobiculatum*, *Panicum frumentaceum*, and Italian millet.—J. F. D.

Contributions from the botanical laboratory and seed-control station of Hamburg, No. 3, 1893, O. BURCHARD (*pp. 20*).—The contributions consist in (1) a report on the seed testing for the year, (2) report on the testing of flour, (3) scientific investigations, and (4) list of contributions from the station.

During the year 280 lots of seed were tested, divided as follows: Leguminosæ 167, grass seeds 79, forest seeds 23, miscellaneous 11. To test these seeds 414 separate investigations were conducted. The table given below is the result of the various tests wherever more than a single sample of seed was tested:

Results of seed testing.

Kind of seed.	Purity.				Germinative energy.				Intrinsic value.		
	No. of tests.	Minimum.	Maximum.	Average.	No. of tests.	Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.
		Per ct.	*Per ct.*	*Per ct.*		*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Trifolium pratense	47	80.04	99.06	96.04	29	71.5	97.25	86.80	70.09	95.43	83.44
Trifolium repens	6	90.13	97.34	93.14	11	61.75	94	81.48	77.06	91.5	82.21
Trifolium hybridum	6	88.51	99.39	96.11	6	71.25	87.25	83.04	70.82	85.12	80
Medicago lupulina	7	95.34	99.11	97.38	7	19.75	93	65.56	19.53	92.17	63.85
Medicago sativa	2	93.94	98.04	95.19	4	76	84	80.38	75.86	82.35	79.11
Ornithopus sativus	2	94.11	95.64	94.88	4	7.17	40	24.17	6.75	38.26	22.51
Onobrychis sativa	2	95.18	98.85	97.02	2	66.67	70.33	68.75	65.90	67.42	66.66
Lolium perenne	7	81.93	94.98	92.31	19	16.33	94.5	62.84	49.29	89.74	65.67
Lolium italicum	1	93.59	97.13	95.36	2	54.5	59.5	56.89	53.03	57.79	50.41
Arrhenatherum elatius	3	82.76	86.52	85.17	3	76.17	81.5	79.67	67.31	70.28	68.74
Festuca ovina	3	60.1	66.97	64.60	8	0.17	90.33	42.31	18.13	52.39	38.43
Festuca elatior	......	......	......	......	2	61.67	71	66.34	......	......	......
Phleum pratense	5	93.09	99.42	96.41	9	33.17	90	79	80.04	85.58	82.65
Dactylis glomerata	6	68.09	89.38	84.78	7	70.5	91.17	79.24	54.70	81.49	68.51
Alopecurus pratensis	5	54.23	83.31	73.92	5	37.67	84.5	83.17	31.18	70.40	67.73
Poa pratensis	7	87.37	90.80	89.25	7	8.5	92.5	67	7.69	79.87	49.38
Picea excelsa	......	......	......	......	2	62.5	86.67	74.59	......	......	......
Pinus sylvestris	......	......	......	......	12	15.67	81.5	58.76	......	......	......

From the above table it is shown that the the minimum of purity was found in *Alopecurus pratensis*, 54.23 per cent, and the maximum in *Phleum pratense*, 99.42 per cent. The minimum for the germinative energy was found in *Festuca ovina*, 0.17 per cent, and the maximum in *Trifolium pratense*, 97.25 per cent. The lowest intrinsic value, which is the purity multiplied by the germinative energy divided by 100, was possessed by *Festuca ovina*, 38.43 per cent, and the highest value by *Trifolium pratense*, 83.44 per cent.

In the investigation for dodder seed in 60 samples of red clover, 28 were absolutely free from dodder, 4 contained from 4 to 10 seeds per kg., and 28 contained from 14 to 11,310 per kg. The species most common was *Cuscuta trifolii*, with occasionally *C. europea*, and more rarely *C. epilinum*. The species found in North American seed was principally *C. racemosa*. The white clover examined gave 50 per cent dodder free, the rest containing from 12 to 684 seeds per kg. Alsike clover gave 42 per cent free and the rest from 36 to 1,129 seeds per kg. One lot of lucern from South America contained 23,600 seeds of *C. chilensis* per kg., and no samples were dodder free. Yellow clover was free from dodder in every case. In two samples of timothy 20 to 284 seeds of *C. epithynum* were found.

The study of the origin of seed based on the weed-seed admixtures was continued.

A report is given of 25 inspections of flour, 18 of wheat, and 7 of rye flour.

Orchard-grass seed of various origins was inspected, and a report is given as to its purity, with a list of over 40 weed seeds found in the various samples. Twelve samples of seed were examined and reported on, as follows:

Purity analysis of orchard-grass seed.

	Australian.						North American.			European.		
Percentage weight of foreign material	10.98	27.49	9.72	11.98	9.04	16.68	11.87	11.39	7.74	34.89	30.28	72.13
Percentage weight of weed seed	0.93	5.33	1.24	0.42	0.70	5.09	4.99	4.56	1.96	28.19	21.87	18.86
Number of species of weeds	3	5	3	3	6	10	9	10	9	22	5	15

It will be seen that the total weight of foreign mixtures, weight of weed seed, and number of species represented by the weed seed of the orchard grass of European origin was greatly in excess of that of either the North American or Australian. The list of weed seeds is so characteristic as to establish the origin of the orchard-grass seed. The most abundant weed seeds found in Australian orchard grass are *Bromus mollis*, *Holcus lanatus*, *Hypochœris radicata*, and *Trifolium* spp. In the North American grass they are *Carex* spp., *Lepidium virginicum*, *Panicum capillare*, *Phleum pratense*, *Poa pratensis*, *Rubus idæus*, *Rumex acetosa*, and *Trifolium* spp. The common weed seeds found in European

seed were *Arrhenatherum elatius*, *Bromus erectus*, *Carum carui*, *Crepis virens*, *Festuca pratensis*, *Holcus lanatus*, *Lolium perenne*, *Medicago lupulina*, *Poa trivialis*, *Rumex acetosella*, and *Trifolium* spp.

Details are given of observations made on various plants while investigating the culture of foreign weed and other seeds.—W. H. E.

The relation between the size and composition of beet seeds and the size and composition of the roots produced by them, N. LASKOWSKY (*Landbote, 14 (1893), No. 60, p. 600*).—Analyses and field experiments made by the author in the Waki district, Russia, seem to indicate that in the smallest seed balls the individual seeds are richest in fat, and that these smallest seed balls produce roots with the highest sugar content. While the data given below are not sufficient to establish a relation between the fat in the seed and the sugar in the beet, they justify, in the author's opinion, further experiments in this line.

The weight of 1,000 large seed balls was 42.9 grams and the fat content 18.7 per cent. The weight of 1,000 small seed balls of the same variety was 16.85 grams, and the fat content 21.03 per cent. The weight of 1,000 individual seeds from large seed balls was 3.89 grams, and of 1,000 seeds from small seed balls, 2.91 grams.

The following table gives the data on which the author's conclusions are based:

Fat content of seed, weight of seed balls and seed, and weight and sugar content of beets.

Variety.	Fat content of seed.	Weight of 1,000 seed balls.	Weight of 1,000 seeds.	Sugar content of beets.	Average weight of each beet.
	Per cent.	*Grams.*	*Grams.*	*Per cent.*	*Grams.*
Vilmorin Improved White	20.7	22.3	2.55	19.5	167
Walkow, from mother beets with 18 per cent sugar	19.8	13.2	2.45	18.5	168
Klein Wanzleben, small seed balls	19.1	16.2	2.54	18.6	197
Klein Wanzleben, from Germany	18.8	22.6	2.78	16.5	369
Walkow, from mother beets with 14 per cent sugar	18.7	24.8	3.36	....	....
Klein Wanzleben, large seed balls	18.5	34.6	3.38	17.1	284

The figures denoting the sugar content are the averages of three determinations, in each of which five beets were used. The author states that almost without exception all the determinations agree closely with the average results.

It appears from the above table that beet seed rich in fat, *i. e.*, that from small seed balls, produced beets richest in sugar but light in weight. An apparent exception to the above is Klein Wanzleben from Germany, which, however, received one watering not given to the other beets, and hence it is not comparable with them. The season in which these experiments were made was exceedingly dry.

The author states that in determining the fat content of beet seed it

is necessary to make the analysis as quickly as possible and to avoid raising the temperature of the drying oven above 100° C.—J. F. D.

Variations in the absorbent power of seeds in proportion to their weight, H. COUPIN (*Bul. Soc. Bot. France, 40* (*1893*), *No. 2, pp. 102–104*).—The absorbent power of seeds is the proportion between the weight of the dry seeds and the amount of water absorbed by them. The author experimented with common beans, kidney beans, corn, and white lupines. Seed was taken from the same package for each test and the samples were considered as equally dry. They were weighed and then placed in distilled water. Every day their weight was noted, and when the seed had reached its maximum weight it was said to be saturated. Tables of results are given showing the average absorbent power of small beans to be 145.01 and larger ones 165.17, giving a difference of 20.16 in favor of the larger seed. For the kidney beans the smaller showed an average absorbent power of 105.43 and the large seed 114.40, giving a difference of 8.97 in favor of the larger seed. For the corn caryopses, small grains had an absorbent power of 56.07, while large ones showed 53.17, a difference in favor of small grains of 2.90. Small lupine seed had an absorbent power of 144.91 and large ones 134.98, a difference in favor of small seed of 9.93.

From the experiments the author concludes that the absorbent power of seed varies considerably with the weight of the seed, although there is no absolute proportion between the two. With some seeds, as common kidney beans, the absorbent power is greatest with large seed, while with corn and lupines it is greatest with the small seed.

The author calls attention, in the study of the absorbent power of seeds, to the necessity of neutralizing as far as possible the individual differences of seed. In such experiments the seed should all be taken from the same package and should be as nearly as possible of the same size.—W. H. E.

The effects of boiling and steaming fresh and salted meat, F. NOTHWANG (*Arch. Hyg., 18, No. 1, pp. 80–93*).—These experiments were instituted for the purpose of ascertaining the loss of weight, of extractive matter, and of salts, resulting from boiling and steaming fresh and salt meat.

Previous experiments by the author had shown that the process of pickling or salting meat resulted in heavy loss of extractive matter and phosphoric acid. A piece of fresh meat weighing 386 grams was salted and left in salt eight days. It had then lost 30 per cent in weight, and contained 47 per cent of dry matter and 9.52 per cent of common salt.

In the present experiments there was found a considerable loss of nutrients when meat, either fresh or salted, was cooked entirely by steam, as well as when it was cooked in water. One hundred grams of fresh meat cooked in water for one, one and a half, and two hours was reduced to 68.9, 59, and 54.6 grams, respectively. When steamed for

the same periods the weights were, respectively, 68.2, 48, 48.2 grams. One hundred grams of salt meat after cooking in water for one, one and a half, and two hours was reduced to 70.7, 66, and 74.8 grams, respectively; steamed for the same periods the weights were 68, 63, and 64.6 grams, respectively. The author belives that the loss of weight was less dependent on the duration of cooking with salt meat than with fresh meat.

The losses in cooking salt meat appeared to be dependent on its percentage of dry matter and of common salt. Salt meat with 32.51 per cent of dry matter and 3.95 per cent of salt weighed after boiling and after steaming only 52.9 and 47 per cent, respectively, of its original weight, while salt meat with 47 per cent of dry matter and 9.42 per cent of salt weighed after boiling and after steaming 70.7 and 67.96 per cent, respectively, of its original weight. The piece containing 3.95 per cent of common salt retained, after boiling, 0.62 per cent of salt reckoned on the original weight of the uncooked meat, or 1.2 per cent reckoned on the weight of the cooked meat. The salt retained after steaming a piece of the meat was 1.82 per cent of the weight of the uncooked piece, or 3.87 per cent of the cooked meat. Meat more strongly salted retained larger percentages of salt than this, after cooking.

The author's analyses showed that the dry matter in boiled unsalted meat was 41.7 per cent; in the same steamed 45.6 per cent; in fresh salted meat, boiled, 52.8; in the same steamed 53.8 per cent. The average loss in boiling or steaming fresh meat was from 50 to 60 per cent of the extractive matter and about 35 per cent of the total phosphoric acid. With salt meat the losses in boiling and steaming were, respectively, 23 and 20 per cent of the extractive matter and about 19 per cent of the phosphoric acid. These losses, added to those sustained in the process of salting, make the total loss of extractive matter in salting and boiling, 65.6 per cent, and in salting and steaming, 67.91 per cent; the total losses of phosphoric acid were 44.45 and 39.50 per cent, respectively.—J. F. D.

Concerning the fatty substances in feeding stuffs and their importance for animal nutrition, E. SCHULZE (*Landw. Jahrb. Schweiz, 6 (1892), pp. 72–80*).—The constituents of the ether extract of feeding stuffs, glycerides or neutral fats, free fatty acids, wax-like substances, cholesterines and related substances, lecithin, and coloring matters, are each briefly described.

The triglycerides or true fats are compounds of glycerin with fatty acids, most commonly with stearic, palmitic, and oleic acids. The character of the free fatty acids has only been definitely determined in a few cases, but it is safe to assume in general that they are analogous to the fatty acids of glycerides. The wax-like substances consist of compounds of fatty acids with certain alcohols (ceryl and myricyl alcohol, etc.). The cholesterines constitute a group of substances named for the gall fat or cholesterin of the body. The cholesterines found in

plants do not entirely agree with those of the body, and so have been designated phytosterin, paracholesterin, caulosterin, etc. Their chemical constitution places them with the alcohols. They occasionally occur in the animal body combined with fatty acids as cholesterides; but whether cholesterides occur in plants is not known. Closely related to the cholesterines is a group of substances differing from them somewhat in composition. Lupeol found in lupine pods and phasol found in bean pods are representatives of this group.

Lecithin is characterized as a "nitrogenous phosphorus-containing fat," since it is composed of glycerin, fatty acids, phosphorus, and a nitrogenous body, cholin. By heating with alkali it yields cholin, glycerin-phosphoric acid, and fatty acids. The author, in collaboration with Likiernik, Steiger, and others, has shown lecithin to be a constituent of plants. When finely ground seeds of plants are treated with ether only a part of the lecithin is dissolved; the rest can be extracted with warm alcohol. It is a peculiar fact that the amount of lecithin extracted by ether from the same kind of seed is very variable.

Besides the above mentioned substances others are sometimes found. Lactic acid and other organic acids soluble in water are frequently present, especially in the ether extract of ensiled fodder.

The ether extract of different feeding stuffs contains these various constituents in widely varying proportions. The author reviews our present knowledge of the composition of the crude fat of different materials.

Grains, seeds, and oil cakes.—In the case of seeds the glycerides predominate as a rule. The crude fat of oil-bearing seeds, as flax, rape, etc., consists for the greater part of glycerides. The extract of seeds of cereals and leguminous plants is also relatively rich in glycerides. Free fatty acids occur in seeds only in small amounts, except, of course, when the seeds have been kept until the fats decompose.

Cholesterines are never lacking, although they are present only in small quantity, seldom constituting more than 5 per cent of the crude fat. Wax-like substances have been found in peas and beans,* but they probably occur in such small quantity as to be unimportant.

Lecithin occurs quite generally in seeds. As mentioned above, the ether extract contains varying, and sometimes only small, amounts of lecithin, but the whole quantity may be extracted with warm alcohol. The results of determinations made in the author's laboratory of the lecithin † in a number of kinds of seed are given below:

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* Ztschr. physiol. Chem., 13, p. 32.

† The lecithin was determined from the amount of phosphorus found in the ether-alcohol extract. (See Ztschr. physiol. Chem., 13, pp. 375–377.)

Lecithin and crude fat in various seeds.

Kind of seed.	In dry matter.	
	Lecithin.	Crude fat.
	Per cent.	*Per cent.*
Wheat	0.65	2.1
Rye	0.57	2.1
Barley	0.74	2.2
Field beans	0.81	2.0
Peas	1.21	2.2
Vetch *a*	1.22	2.4
Vetch *b*	0.74	
Yellow lupine *a*	1.55	5.4
Yellow lupine *b*	1.59	
Soja bean	1.64	19.7
Flax	0.88	37.0
Hemp	0.87	35.8

The above figures show that in the case of seeds of a low fat content the lecithin content is very considerable in comparison with the crude fat. In oil-bearing seeds the lecithin is relatively much lower, and this is true for the press cakes. Triglycerides predominate in the ether extract of oil cakes, although considerable quantities of free fatty acids have occasionally been found. The quantity of the latter appears to increase as the oil cakes age, owing to a decomposition of the glycerides. Small quantities of lecithin and cholesterin are found in oil cakes, and although wax-like substances have not been found as yet, their presence is considered very probable. Analyses given of a number of kinds of oil cake show the lecithin content of the dry matter to vary from 0.04 per cent in peanut cake to 0.23 per cent in palm-nut cake. While the flaxseed contained 0.88 per cent of lecithin, the linseed cake contained only 0.1 per cent.

Hay and coarse fodder.—The ether extract of meadow hay, when freed of its chlorophyll with charcoal and evaporated, gives a yellowish, waxy, crude fat with a relatively high melting point. Glycerides are either absent entirely or only present in such small quantities that their recognition is difficult.* On the other hand, the fat is rich in wax-like substances, and free fatty acids, cholesterin, and hydrocarbon have been found.

The crude fat of oat straw appears to be very similar to that of meadow hay. The crude fats of other coarse fodders have been very little studied, but it is suggested that they may be quite similar in character and composition to that of hay and oat straw.

The ether extract of potato tubers, fodder roots, and malt sprouts is relatively rich in free fatty acids and also in cholesterin and related substances, but probably contains only a trace of glycerides.

Nutritive value of constituents of ether extract.—Concerning the bearing of the above on the question of the nutritive value of ether extract, the author enumerates the uses of fat in the body, *i. e.*, (1) sustaining respiration and maintaining heat, (2) economizing albuminoids, (3) form-

*Landw. Vers. Stat., 15, p. 81, and 16, p. 41.

ing fat in the body, and (4) favoring digestion, when present in moderate quantity; and he mentions that all studies of its value in nutrition have been made by feeding glycerides (fatty oils and the like) or substances rich in glycerin, as oil cakes, certain seeds, etc. Hence, the statement that fat is worth two and one half times as much as the carbohydrates applies strictly to the true fats, or glycerides, and not to the mixtures constituting the ether extracts of feeding stuffs.

It is considered very probable that the free fatty acids are of very similar nutritive value to the glycerides, since in the process of digestion of the fats a portion is decomposed by the pancreatic juice to glycerin and free fatty acids, in which form the latter, after being saponified by alkali, may be used directly by the body. Whether or not the fatty acids very rich in carbon, as the cerotinic acid found in meadow hay, can be utilized in this manner is a matter of some doubt.

Lecithin is believed to possess considerable nutritive value. According to the investigation of Bokay* and Hasbroek,† lecithin being an easily decomposed substance breaks up under the influence of the pancreatic juice into fatty acids, glycerin-phosphoric acid, and cholin. As to the nutritive value of the fatty acids, there can be little doubt that they are of equal value with those derived in the digestion of the glycerides. Since lecithin yields about 70 per cent of fatty acids when decomposed, it may be regarded as approaching the glycerides in nutritive value. It is not known whether the two other products of the decomposition, glycerin-phosphoric acid and cholin, possess nutritive value, but in any case their proportion is small.

While it may be assumed, then, that the fatty acids and lecithin approach the glycerides in nutritive value, the other constituents of the ether extract—*i. e.*, wax-like substances, cholesterines and similar substances, and hydrocarbons—are of doubtful value. If these substances are digested in part even, it is not known what part they play in metabolism.

From what has been said the conclusion is that the ether extract of seeds and their by-products, as oil-cakes, brans, etc., is of high nutritive value, being rich in glycerides and containing considerable quantities of free fatty acids and lecithin, while the proportion of substances of doubtful value is relatively small. In the case of hay and coarse fodders, on the other hand, the nutritive value of the ether extract must be considered as low, for it consists mainly of wax-like substances and others of doubtful value, with little, if any, glycerides. The same applies to potatoes, fodder roots, and malt sprouts.

The coëfficient of digestibility of the crude fat is not, in the opinion of the author, a proper basis for comparing nutritive values of the crude fat of various feeding stuffs, for the constituents mentioned above as of doubtful value are not wholly undigested. However, we are not

*Ztschr. physiol. Chem., 1, p. 157. †Ibid. 1, p. 148.

warranted in assuming that the portions digested possess equal nutritive value with the glycerides, fatty acids, and lecithins. Furthermore, the coëfficients found for the crude fat of coarse fodders vary so widely in case of one and the same kind of fodder that the averages are to be regarded as of very limited value.—E. W. A.

The physiological and pathological effect of feeding soured beet diffusion residue, M. ARLOING (*Sucerie indigène, No. 27, p. 791; abs. in Oesterr. ungar. Ztschr. Zuckerind. und Landw., 1893, No. 1, pp. 127–131*).—The use of soured diffusion residue from beet-sugar factories as food for ruminants may cause various diseases, as *Mauke* and others. In the fluid separated from this residue the author found several forms of bacteria. He sought to ascertain the cause of the disease by injecting various quantities of this fluid, previously filtered, into the subcutaneous tissues and into the veins of rabbits, dogs, and lambs. Shortly after a copious injection into the veins, violent cramps set in, soon ending in death. Smaller injections caused cramps of the chest muscles, followed by death in about twenty-four hours. The dose necessary to produce death varied from 3 to 4 c. c. per kg. of live weight. In the cells of the liver of the dead animals occurred a fatty mass which contained great numbers of bacteria. The blood was so impregnated with bacteria that decomposition set in soon after death.

In order to preserve beet residue from decay it should be neutralized, heated, or treated with a solution of common salt as soon as it leaves the factory. The author's experiments had reference to the last method. He injected into rabbits the liquid from refuse which had been treated with salt solutions of different strengths, and found that such treatment greatly lessened the poisonous properties. He states that when a salt solution of 0.20 to 0.25 per cent strength is used cattle can eat from 50 to 60 kg. of beet chips per day without injury.

Into a rabbit was injected some of the highly poisonous liquid, alternating with an injection of 25 c. c. of a 4 per cent salt solution. The rabbit was not injured. The author not only recommends the use of a solution of common salt as a preventive measure, but advises its use in the treatment of this disease.—J. F. D.

Report on the etiology and pathology of "louping ill," E. KLEIN (*Jour. Roy. Agr. Soc. England, 4, 1893, No. 15, pp. 625–636*).—This disease occurs among sheep in particular districts in Northumberland and Scotland, and the author does not know of its existence south of Northumberland. The most conspicuous symptom of the disease consists in muscular disorder. In the earlier stages the animals show jumping movements; later the power of movement is entirely lost. A post mortem examination reveals a congested condition of certain parts of the brain and of the lungs, as well as other less characteristic indications.

This disease appears in the second half of April, is most prevalent about the middle of May, and disappears about June 1. A fence between

two sheep farms is frequently the boundary between an infected and an uninfected area. The author believes that the primary cause of this disease exists on or in the soil. When a healthy flock is brought on to land from which a diseased flock has been removed the disease appears in the former. In the districts where louping ill occurs it is the custom to leave the carcasses unburied, and to this the author attributes in large part the prevalence of the disease.

The popular local belief is that louping ill is caused by the "white tick," as opposed to the ordinary or black sheep tick. This tick is present whenever the disease occurs, but the author is skeptical of the assertion made by shepherds and farmers that this insect is not present in regions free from louping ill. In infected localities this tick occurs not only on diseased sheep, but on healthy animals; hence the author concludes that the tick is not the real or proximate cause of the disease, but admits a "remote" possibility that the tick may be the carrier of infection.

The disease is apparently communicated from one animal to another. With a few exceptions, when a ewe is attacked her lamb also becomes ill, but the lamb is frequently sick without communicating the disease to its mother, which fact the author explains by stating that it is the custom to remove sick lambs from their mothers, but to allow healthy lambs to remain with sick ewes. Cattle also are liable to the disease, but as a rule recover.

In the present year, contrary to the usual local custom, diseased sheep were separated from the flock as soon as attacked. For this reason, as the author believes, the season of epidemic was in this year shorter than usual.

A microscopic examination of the cerebral fluid of diseased animals showed that in six out of seventeen cases one and the same definite species of bacillus was present, and this form was successfully grown on cultures. From the diseased portion of the lung this bacillus was found in only two cases and its presence was not detected in the blood. The author admits that the connection between this bacillus and the disease is slight.

Rabbits, Guinea pigs, and mice were inoculated with cultures of the bacillus from the cerebral fluid, with no further result than the production of local swellings. A few lambs were also inoculated with a culture of this bacillus, but were not seriously affected, if at all.—J. F. D.

On the lecithin content of butter, E. WRAMPELMEYER (*Landw. Vers. Stat., 42, No. 6, pp. 437, 438*).—Beilstein (second edition, vol. I, p. 394) gives the lecithin content of butter as 0.15 to 0.17 per cent. It occurred to the author that this lecithin content might furnish a means for the recognition of margarin in butter. While not successful in this respect, his results are, nevertheless, of interest. The lecithin was determined from the phosphoric acid content of the ash of 100 grams of butter or margarin. While 100 grams of butter gave 0.04512 gram

of phosphoric acid, 100 grams of margarin gave only 0.0160 gram. The method was not very convenient and was subject to error from the phosphoric acid in the salt. Hence determinations were made in filtered fat. Margarin ash then showed only a trace of phosphoric acid, too small to be estimated. Butter ash not only showed considerably less phosphoric acid than that from unfiltered butter, but the amount was very variable.

The following table shows the results of examination of butter from different sources:

Examination of butter for lecithin, etc.

Source.		Melting point.	Point of crystallization.	Volatile fatty acids.*	Distearin lecithin.
Province.	Soil.				
		Degrees C.	*Degrees C.*		*Per cent.*
Gelderland	Clay	40.6	27.0	26.9	0.033
Friesland	Clay	39.2	25.9	29.3	0.007
Friesland	Sand	37.0	25.2	30.5	0.011
Groningen	Much clay with sand	38.9	26.1	29.4	0.015
Friesland	Clay	37.9	24.6	28.0	0.033
Friesland	Sand and clay	38.2	24.0	29.0	0.011
Friesland	Clay	38.2	24.1	28.3	0.011

* C. c. of decinormal alkali refined by 5 grams of fat.

Assuming the phosphoric acid to be all derived from the lecithin, the average lecithin content was 0.017 per cent.—E. W. A.

Sulphur in cows' milk, A. SARTORI (*Chem. Ztg., 17 (1893), No. 59, p. 1070, No. 63, p. 1138*).—The author reports finding sulphur to the extent of 0.043 per cent in cows' milk sold for infants. The milk was delivered in corked bottles and was examined about six hours after milking. The cows furnishing this milk were fed in the barn exclusively, and received ground oats, wheat bran, linseed cake, sunflower-seed cake, clover hay, wheat chaff, and clean barley straw. A little hydrochloric acid was added to the water they drank.

The author is in doubt as to whether the sulphur found is entirely accounted for by that in the casein. He promises further studies on the question.—E. W. A.

TITLES OF ARTICLES IN RECENT FOREIGN PUBLICATIONS.

CHEMISTRY.

Concerning the essence of lavender (*Sur l'essence d'Aspic*), G. BOUCHARDAT.—*Compt. Rend., 117 (1893), No. 1, pp. 53–56.*

Preparation of citric acid by synthesis; by the fermentation of glucose (*Préparation d'acide citrique de synthèse; par la fermentation du glucose*), C. WEHMER.—*Compt. Rend., 117 (1893). No. 7, pp. 332, 333.*

Concerning the coagulation of albumen (*Sur la coagulation de l'albumine*), E. DUCLAUX.—*Ann. Inst. Pasteur, 7 (1893), No. 9, pp. 641–664.*

Volumetric determination of phosphoric acid and alkaline pyrophosphates, C. FARRELL.—*Bul. Soc. Chim. Paris, 9 and 10, ser. 3, No. 12.*

Some new apparatus for use in the Thörner method of determining fat (*Einige neue Hilfsapparate für die Fettbestimmungen nach der Thörnerschen Methode*), H. GREFF.—*Milch Ztg., 22 (1893), No. 37, pp. 608–610.*

Application of sodium peroxide to water analysis, S. RIDEAL and H. J. BULT.—*Chem. News, 68, No. 1769, pp. 190, 191.*

Report on laboratory experiments to ascertain the effect of heating alkaline sugar solutions (*Bericht über die von deutschen Vereinslaboratorium angestellten Versuche zur Ermittlung der beim Verdampfen alkalischer Säfte entstehenden Zuckerverluste*), A. HERZFELD.—*Gelbe Hefte, 1893, p. 745; abs. in Wochenschr. Cent. Ver. Rübenz. Ind., 31 (1893), No. 39, p. 596.*

GEOLOGY.

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Anatomical characteristics of the stem of the Dioscoreæ (*Caractéres anatomiques de la tige des Dioscoreæ*), C. QUEVA.—*Compt. Rend., 117 (1893), No. 5, pp. 295–297.*

A contribution to the chemistry and physiology of foliage leaves, H. T. BROWN and G. H. MORRIS.—*Jour. Chem. Soc. London, 1893, pp. 604–683; abs. in Bot. Centbl., 55 (1893), No. 8, pp. 238–340.*

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The appearance and physiological significance of myrosin in plants (*Ueber das Auftreten und die physiologische Bedeutung des Myrosins in der Pflanze*), W. SPATZIER.—*Inaugural Dissertation Erlangen, 1893; abs. in Bot. Centbl., 55 (1893), No. 10, pp. 303–305.*

Starch formation, H. T. BROWN and G. H. MORRIS.—*Abs. in Gard. Chron., ser. 3, 14 (1893), p. 161.*

The "Keimplasma," a theory of heredity (*Das Keimplasma, eine Theorie der Vererbung*), A. WEISMANN, *1892, pp. 628; abs. in Bot. Centbl., 55 (1893), No. 8, pp. 241–245.*

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Henequen (sisal) hemp in Yucatan.—*Kew Misc. Bul. No. 80, p. 212.*

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Soluble ferments (*Untersuchungen über lösliche Fermente*), J. JACOBSOHN.—*Ztschr. physiol. Chem., 16 (1892), pp. 340–369; abs. in Bot. Centbl., 55 (1893), No. 9, pp. 271, 272.*

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Remarks on the chemistry of bacteria, R. WARINGTON.—*Chem. News, 68, No. 1768, pp. 175, 176.*

Bacteriological examination of air from great altitudes (*Analyse bactériologique de l'air des hauteurs*), H. CHRISTIANI.—*Ann. Inst. Pasteur, 7 (1893), No. 9, pp. 665–671.*

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Rainfall and drainage at Rothamsted, J. J. WILLIS.—*Gard. Chron., ser. 3, 14 (1893), p. 392.*

Concerning the origin of the oxygen of the atmosphere (*Sur l'origine de l'oxygène atmosphérique*), T. L. PHIPSON.—*Compt. Rend, 117 (1893), No. 6, pp. 309, 310.*

London water supply; analysis of samples taken during August, 1893, W. CROOKES and W. ORDLING.—*Chem. News, 68, No. 1766, p. 153.*

Apparatus for sterilizing and pasteurizing water and other liquids (*Apparat zum Sterilisiren und Pasteurisiren von Wasser und anderen Flüssigkeiten.*—*Chem. Ztg., 17 (1893), No. 74, p. 1344.*

A simple method of sterilizing water for domestic purposes, F. WATTS.—*Chem. News, 68, No. 1768, p. 178.*

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The sands of the desert of Lower Egypt (*Les sables du désert de la Basse-Egypte*), A. ANDOUARD.—*Compt. Rend., 117 (1893), No. 4, pp. 258–261.*

Note on the composition of the fen and marsh soils of South Lincolnshire, E. W. BELL.—*Chem. News, 68, No. 1769, pp. 191, '92.*

The chemical analysis of soils in its relation to fertilizer experiments (*Die chemische Bodenanalyse in ihrer Beziehung zu den Düngungsversuchen*), VON LIEBENBERG.—*Mitt. Ver. Förd. landw. Versuchswesens Oesterr., 1893, No. 8, part I, pp. 26–41.*

Concerning the presence of common salt in certain clay soils (*De la présence du sel marin dans quelques types de linion*), X. STANIER.—*Bul. Min. Agr. Belgique, 9 (1893), No. 1, pp. 28–30.*

Fermentations in the soil (*Ackergähre*), A. VON SIVERS.—*Balt. Wochenschr. Landw.; abs. in Braunschw. landw. Ztg., 61 (1893), No. 35, pp. 146, 147.*

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Concentrated cattle manure (*Concentrirter Rinderdünger*), I. RECHT.—*Wiener landw. Ztg., 43 (1893), No. 63, p. 520.*

Experiments in preserving manure (*Zur Frage der Düngerkonservierung*), H. ROSTOCK.—*Deut. landw. Presse, 20 (1893), No. 79, pp. 823, 824.*

The greater assimilability of the nitric nitrogen of recently formed nitrates (*Assimilabilité plus grande de l'azote nitrique des nitratés récemment formés*), P. PICHARD.—*Compt. Rend., 117 (1893), No. 2, pp. 125–127.*

Fertilizer experiments with fodder beets, taking account of the chemical composition of the soil (*Düngungsversuche zu Futterrübe unter Berücksichtigung der chemischen Bodenanalyse*), E. VON PROSKOWETZ, JR.—*Mitt., Ver. Förd. landw. Versuchswesens Oesterr., 1893, No. 8, part I, pp. 42–52.*

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Fertilizer experiments with orthophosphoric acid on cereals) *Düngungsversuche mit Orthophosphorsäure*), VON LIEBENBERG.—*Mitt. Ver. Förd. landw. Versuchswesens Oesterr., 1893, No. 8, part I, pp. 3–13.*

Fertilizer experiments with steamed ground bone for cereals (*Düngungsversuche mit gedämpftem Knochenmehle*), VON LIEBENBERG.—*Mitt. Ver. Förd. landw. Versuchswesens Oesterr., 1893, No. 8, part I, pp. 21–25.*

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Polygonum sachalinense.—*Gard. Chron., ser. 3, 14 (1893), p. 158.*

Polygonum cuspidatum as a forage plant (*Polygonum cuspidatum*), KRÜGER.—*Deut. landw. Presse, 20 (1893), No. 68, p. 706.*

Anthyllis vulneraria as a forage plant (*Anthyllis vulneraria*).—*Fühling's landw. Ztg., 42 (1893), No. 17, p. 582.*

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A study of hops (*Beiträge zur Kenntniss des Hopfens*), HOLZNER and LERMER.—*Ztschr. Brauwesens, 16 (1893), pp. 1–4; abs. in Bot. Centbl., 55 (1893), No. 9, p. 274.*

The development of the peanut (*Développement de l'Arachide*), A. ANDOUARD.—*Compt. Rend., 117 (1893), No. 5, pp. 298–300.*

Experiments with varieties of rye (*Versuche über den Anbauwert verschiedener Getreidespielarten*), N. WESTERMEIER.—*Deut. landw. Presse, 20 (1893), No. 72, pp. 751, 752.*

Experiments with varieties of rye (*Roggenanbauversuche in Heraletz*), C. SOMMER.—*Wiener landw. Ztg., 43 (1893), No. 74, p. 610.*

Experiments with varieties of wheat (*Versuche über den Anbauwert verschiedener Getreidespielarten*), N. WESTERMEIER.—*Deut. landw. Presse, 20 (1893), No. 74, p. 768.*

The quantity of nitrogen in the roots and aerial portions of horse beans, lentils, crimson clover, lupine, and Lathyrus sativus (*Contributo allo studio dei concimi*), V. OLIVIERI and M. SPICA.—*Agricol. Ind. Agr., 16 (1893), No. 15, pp. 244, 245.*

Concerning the carbohydrates of the Jerusalem artichoke (*Sur les hydrates de carbone du topambour*), C. TANRET.—*Compt. Rend., 117 (1893), No. 1, pp. 50–53.*

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Changes occurring during the storage of grain (*Einige Vorgänge biem Lagern des Getreides*), M. MAERCKER.—*Landbote, 14 (1893), No. 59, pp. 594, 595.*

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Pedigree of grade races in horticulture, H. L. VILMORIN.—*Gard. Chron., ser. 3, 14 (1893), pp. 301–332.*

The forced culture of lettuce (*Culture forcée de la romaine*), G. ALLUARD.—*Rev. Hort., 65 (1893), No. 16, p. 371.*

Concerning a new method of cultivating mushrooms (*Sur un nouveau procédé de culture du champignon de couche*), J. COSTANTIN and L. MATRUCHOT.—*Compt. Rend., 117 (1893), No. 1, pp. 70–72.*

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The resin of conifers, MAYR.—*Ztschr. Forst. Jagd, June, 1893; abs. in Gard. Chron., ser. 3, 14 (1893), p. 327.*

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A comparison of red clover from American and from German seed (*Werth des amerikanischen Rothklees*), F. J. WAGNER.—*Wiener landw. Ztg., 43 (1893), No. 62, p. 511.*

Influence of age on the germination of seed (*Einfluss des Alters auf die Keimfähigkeit der Samen*), MÜLLER.—*Landbote, 14 (1893), No. 70, p. 689.*

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Fungi on mushroom beds, M. C. COOKE.—*Gard. Chron., ser. 3, 14 (1893), p. 299.*

Note on diseases of mushrooms (*Note sur les champignons appelés "Oreilles de chat"*), J. COSTANTIN.—*Bul. Soc. Mycol. France, 9 (1893), No. 2, pp. 87–89; abs. in Bot. Centbl., 55 (1893), No. 10, p. 313.*

A poisonus fungus, M. C. COOKE.—*Gard. Chron., ser. 3, 14 (1893) p. 361.*

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The injurious fungi of greenhouses (*Die schädlichen Kryptogamen unserer Gewächshäuser*), P. HENNINGS.—*Gartenflora, 1893, p. 532.*

A fungus disease of tobacco (*Trockene und nasse Faule des Tabaks "der Dachbrand"*), J. BEHRENS.—*Ztschr. Pflanzenkrank., 1893, p. 82; abs. in Bot. Centbl., 55 (1893), No. 10, p. 313.*

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Concerning a root disease of lucern (*Sur le Rhizoctone de la luzerne*), A. PRUNET.—*Compt. Rend., 117 (1893), No. 4, pp. 252–255.*

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Concerning the composition of linden honey dew (*Sur la composition de la millée du Tilleul*), MAQUENNE.—*Compt. Rend., 117 (1893), No. 2, pp. 127–129.*

A fungus parasite of the silk worm (*Un entomophage parasite de vers a soié européens*), E. L. BOUVIER and G. DELACROIX.—*Compt. Rend., 117 (1893), No. 4, pp. 245–247.*

Concerning a parasitic fungus of Cochylis, (*Sur un champignon parasite de la cochylis*), C. SAUVAGEAU and J. PERRAUD.—*Compt. Rend., 117 (1893), No. 3, pp. 189–191.*

Aphodius fimetarius and other insects and mites destructive to mushrooms (*Le Suisse (Aphodius fimetarius), et quelques autres insectes et acariens nuisibles au champignon de couche*), J. C. COSTANTIN.—*Bul. Soc. Mycol. France, 9 (1893), No. 2, pp. 84–86; abs. in Bot. Centbl., 55 (1893), No. 10, p. 312.*

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The destruction of wasps (*Destruction des guêpes*), P. LESNE.—*Rev. Hort., 65 (1893), No. 17, p. 403.*

Concerning the influence of drought on the increase of certain injurious garden insects, with special reference to wireworms and mole crickets (*Ueber den Einfluss der Trockenheit auf die Vermehrung einiger dem Gartenbau schädlicher Insekten, mit besonderer Berücksichtigung des Drahtwurms und der Maulwurfsgrille*), G. RÖRIG.—*Fühling's landw. Ztg., 42 (1893), No. 17, pp. 574–578.*

FOODS—ANIMAL PRODUCTION.

St. Vincent arrowroot.—*Kew Misc. Bul., No. 80, p. 191.*

The value of earth-nut (peanut) cake as a feeding material, W. R. ROBINSON.—*Jour. Roy. Agr. Soc. England, 4 (1893), No. 15, pp. 648–651.*

Fish meal as a food stuff (*Fischfuttermehl*), F. LEHMANN.—*Hannoverschen landw. und forstw. Ztg., 1893, No. 19; abs. in Fühling's landw. Ztg., 42 (1893), No. 16, pp. 537–541.*

Grinding concentrated food for cattle (*Zerkleinerung des Kraftfutters für Rinder*), BRÜMMER.—*Wiener landw. Ztg., 43 (1893), No. 68, pp. 560, 561.*

The preparation of concentrated food for swine (*Die Zubereitung des Kraftfutters für Schweine*), BRÜMMER.—*Wiener landw. Ztg., 43 (1893), No. 69, p. 568.*

Rational feeding of upland and lowland cattle for milk and beef production (*Rationelle Fütterung zur Milch- und Fleischproduktion bei Niederungs- und Höhenvieh*), DRÖGE.—*Deut. landw. Presse, 20 (1893), No. 66, p. 689; No. 68, p. 707.*

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Slaughter experiments (*Probeschlachtungen und Fleischqualität*), C. LEHMANN.—*Deut. landw. Presse, 20 (1893), No. 75, pp. 775, 776, figs. 8; No. 76, pp. 783–785, figs. 2.*

VETERINARY SCIENCE AND PRACTICE.

Concerning the effects of the slow destruction of the pancreas (*Sur les effets de la destruction lente du pancreas*), E. HEDON.—*Compt. Rend., 117 (1893), No. 4, pp. 238–240.*

The antiseptic properties of the essences of niaouli and cajeput (*Contribution a l'etude des essences au point de vue de leurs propriétés antiseptique*), F. FORNÉ.—*Ann. Inst. Pasteur, 7 (1893), No. 7, pp. 529–535.*

Concerning phagocytosis in actinomycosis (*Sur la phagocytose dans l'actinomycose*), A. PAWLOWSKY and M. MAKSUTOFF.—*Ann. Inst. Pasteur, 7 (1893), No. 7, pp. 544–549.*

Inoculation as an aid in combating foot and mouth disease (*Die Impfung als Hülfsmittel zur Bekämpfung der Maul- und Klauenseuche*), PÜTZ.—*Milch Ztg., 22 (1893), No. 36, pp. 587–589.*

Experiments on the transmission and the evolution of certain epithelial tumors on white mice (*Expériences sur la transmission et l'évolution des certaines tumeurs épithelioles chez souris blanche*), H. MORAN.—*Compt. Rend., 117 (1893), No. 1, pp. 62–65.*

DAIRYING.

On "soapy" milk, and the source of bacteria in milk (*Ueber "seifige" Milch und über die Herkunft der Bakterien in der Milch*), H. WEIGMANN and E. ZIRN.—*Milch Ztg., 22 (1893), No. 35, pp. 569–571.*

Ahlborn's apparatus for the Babcock milk test (*Die Ahlbornsche Ausführung des Babcockschen Fettbestimmungsapparates*).—*Milch Ztg., 22 (1893), No. 37, pp. 610–612, figs. 6.*

A new modification of the Babcock milk test and its utility (*Ueber eine neue Modifikation des Babcock'schen Verfahrens und deren Brauchbarkeit*), R. KRUEGER.—*Molk. Ztg., 7 (1893), No. 36, pp. 489, 490, figs. 6; No. 37, pp. 505, 506.*

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Purification of beet juice by means of sulphite of soda (*Die Reinigung von Zuckersäften durch schwefligsaures Natron*), RUMPLER.—*Deut. Zuckerind., 1883, p. 1309; abs. in Wochenschr. Cent. Ver. Rübens. Ind., 31 (1893), No. 39, p. 595.*

The application of asbestus in the filtration of juices and sirups, P. MARGNEN.—*Bul. Assn. Chim., 1893, p. 881; abs. in Wochenschr. Cent. Ver. Rübenz.-Ind., 31 (1893), No. 39, p. 596.*

Soxhlet's new process for refining sugar (*Ein neues Zucker-Raffinationsverfahren*).—*Deut. landw. Presse, 20 (1893), No. 70, p. 725.*

Sulphuric acid in wines (*L'acide sulfureux dans les vins*), E. CHUARD and M. JACCARD.—*Chron. Agr. Cant. Vaud, 1893, No. 10, pp. 381–385.*

Concerning the aging of wines (*Sur le vieillissement des vins*), E. DUCLAUX.—*Ann. Inst. Pasteur, 7 (1893), No. 7, pp. 536–543.*

Investigations concerning the chemical composition of must and wine in the Prussian wine industry (*Untersuchungen über die chemische Zusammensetzung der Moste und Weine des preussischen Weinbau gebeites*), P. KULISCH.—*Ztschr. angew. Chem., 1893, No. 16, pp. 473–485; No. 19, pp. 567–573.*

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Miscellaneous implements exhibited at Chester, J. EDWARDS.—*Jour. Roy. Agr. Soc. England, 4 (1893), No. 15, pp. 552–571, figs. 12.*

Trials of eleven grain harvesters in Scotland (*Prüfung von Bindemähemachinen*).—*Abs. in Deut. landw. Presse, 20 (1893), No. 75, p. 779.*

Tests of plows (*Bericht über die Pflugprüfung des Vereins zu Förderung der Moorkultur in Deutschen Reiche zu Lobeofsund am 8 und 9 August, 1893*), F. POGGE.—*Landbote, 14 (1893), No. 72, pp. 707–710.*

Trials of sheep-shearing machines at Chester, W. ANDERSON and A. J. SMITH.—*Jour. Roy. Agr. Soc. England, 4 (1893), No. 15, pp. 547–552.*

MISCELLANEOUS.

A text-book on tropical agriculture, H. A. A. NICHOLS, 1892. *Abs. in Bot. Centbl., 55 (1893), No. 9, p. 280.*

Typical farms in Cheshire and North Wales, J. BOWEN-JONES.—*Jour. Roy. Agr. Soc. England, 4 (1893), No. 15, pp. 571–620, figs. 6.*

Report of the sixty-fifth convention of the Association of German Naturalists and Physicians at Nuremberg (*65 Versammlung der Gesellschaft deutscher Naturforscher und Aerzte zu Nürnberg von 11 bis 15 September, 1893*).—*Chem. Ztg., 17 (1893), No. 74, pp. 1338–1344; No. 75, pp. 1362–1367; and No. 76, pp. 1382–1393.*

EXPERIMENT STATION NOTES.

CALIFORNIA STATION.—Two forestry stations, one at Chico, the other at Santa Monica, heretofore established under a State law creating a State Board of Forestry, have by a recent act of the legislature been transferred to the experiment stations under control of the University of California, with a small appropriation which will suffice to stock and increase the area planted. C. C. Royce has been appointed patron of the Chico Station; and H. J. Kiruckeberg, patron, and William J. Strachen, foreman of the Santa Monica Station.

James W. Mills has been appointed foreman of the South California Station vice K. McLennan resigned. L. Paparelli having resigned, A. P. Hayne has been made graduate assistant in viticulture; and Marvin Curtis, temporary assistant chemist in the general laboratory.

Besides the usual current laboratory work on soils, waters, etc., investigations are being made on the changes produced in alkali soils during reclamation with gypsum; also on the nitrogen content of humus, the results appearing to show that the percentage of nitrogen in the humus of soils of arid climates exceeds overwhelmingly that usually found in humid climates.

For the first time since the establishment of the several stations, grapes are now coming in which represent the same varieties grown under varied climatic and soil conditions, and are being examined as to the influence of climate and soil upon the various ingredients and upon the wine-making qualities of each variety.

Experiments are also being made regarding the royal mold (*Botrytis cinerea*), the occurrence of which has been noted abundantly on grapes.

Splendid results have been obtained this year in the reclamation tests with gypsum upon the alkali tract at the San Joaquin Station. A growth of wheat and barley, 5 feet in height and with large full heads, has been produced upon a portion of the tract which a couple of years ago was so charged with carbonate of soda ("black alkali") that nothing would grow on it.

KANSAS STATION.—D. H. Otis has been appointed assistant in agriculture.

A STRANGE FERTILIZER FORMULA.—This Office is in receipt of a circular from Alabama which states in substance that for the sum of $5 any farmer may exercise the privilege of making Roach & Wallis' fertilizer compound, according to the following formula:

"Take saltpetre, 2 pounds; bluestone, 2 pounds; soda ash, 4 pounds; nitrate ammonia, 2 pounds; potash, 4 pounds. Dissolve the whole in 6 gallons of water. Put 100 pounds stable manure in a pen and sprinkle with a portion of the solution. Then take 50 pounds unleached ashes, 5 pounds salt, and 5 pounds lime; sprinkle these on the manure; continuing the above process until the ton is completed, and let it remain under shelter for 30 days. Use from 200 to 400 pounds per acre, and bed on it as other fertilizers.

"This is the preferred formula, but it may be variously modified without departing from the principle of our invention so long as the same steps are taken in the manner of preparation."

Several modifications are suggested, for which no extra charge is made, such as the following: "If a lower grade of fertilizer is desired, use less of the ingredients; if a higher grade, use more. * * * To use as guano put in sand instead of stable

manure, and add 50 pounds more of lime to the ton, 6 pounds more ammonia, and 50 pounds more salt. For land that is infested with bugs and worms that destroy young plants, put in 10 pounds bluestone to the ton."

We are informed by the U. S. Patent Office that the application for a patent for this fertilizer has been rejected, as it certainly ought to have been.

FERTILIZER INSPECTION AND ANALYSES IN INDIANA.—In special bulletins of Purdue University for May and August, 1893, H. A. Huston, State chemist, gives statistics regarding the fertilizer trade in Indiana; popular discussions of the physical and chemical improvement of the soil, direct fertilization, and coarse manures; notes on valuation and on the State fertilizer law; and tabulated analyses of 545 samples of fertilizing materials including bone, dissolved bone, nitrate of soda, and compound fertilizers.

THE CLIMATE OF THE EASTERN PORTION OF THE COAST DISTRICT OF TEXAS IN ITS RELATION TO THE CULTIVATION OF FRUITS AND VEGETABLES.—In view of the importance which the growing of fruits and vegetables appears likely to assume in this region J. L. Cline summarizes and discusses in the *American Meteorological Journal*, (*10, No. 4, pp. 155–163*), the meteorological records for Galveston, New Ulm, Houston, Brazoria, Columbia, and Orange for the years 1873–1892.

The normal rainfall of the district is 51.54 inches and is generally well distributed. The temperature rarely falls below 20° F. and the minimum temperature is generally between 25° and 30° F. A maximum temperature of 100° has not been observed in twenty years.

"The extreme southern portion of this district is subject nearly every winter to light frosts. * * * The average date of first killing frost 60 miles from the coast is December 15, while along the immediate coast it is December 25. The average date of last killing frost in spring along the edge of the coast is January 5, while 50 miles inland it is February 1.

"During the past few years fruit and vegetables have been cultivated very extensively over the eastern portion of the coast district, and it has been proved that apricots, peaches, pears, oranges, strawberries, dates, limes, bananas, figs, grapes, Japanese persimmons, almonds, pomegranates, pecans, quinces, and blackberries can be grown, and some of them with marked success. The cultivation of strawberries is being carried on very extensively over the eastern portion of the coast district. The berries raised are of the finest grade and are very large. With few exceptions the berries grown in this portion of the State are ready for market by the last of February, which is generally from one to two weeks earlier than they can be marketed from any other section of the country. The banana has not been cultivated very extensively over this section for the reason that it is only a few years since it has been raised successfully. * * *

"Grapes are classified among the leading fruits for cultivation over this section of the State, and it is proved that the climate along the coast is better suited for the varieties of grapes known as the Delaware, Ives, Champion, Niagara, and Concord. * * *

"The pear is a sure crop over this district and is of unusually large size and of fine flavor. The olive thrives as far north as the thirty-second parallel, and it is believed that in the course of a few years, the cultivation of the olive will be one among the leading industries carried on over portions of this district.

"It is believed in the course of time that every acre of land over this territory will be under cultivation, and it will be one of the leading fruit-growing sections of the country."

INSECT ON DAHLIAS AND CHRYSANTHEMUMS.—The frequent failure of dahlias and chrysanthemums to bloom has been a cause of much disappointment. A recent writer in *Garden and Forest* (*vol. VI, p. 448*) attributes the failure to attacks of an insect, *Lygus lineolaris*, upon the flower buds. He finds that the buds fail to develop whenever stung by this insect.

GRAPES AS FOOD FOR PIGS.—According to the Visalia *Times* (*Garden and Forest, vol. VI, p. 450*), a vineyardist in that part of California has found that he can fatten a hundred pigs on the second crop of grapes in his 50-acre vineyard. The grapes are not picked for the swine, but the swine are turned in among them and allowed to pick for themselves, which they are said to do without injuring the vines. In sixty days they gained an average of 100 pounds each.

STATION FOR FLAX CULTURE.—The Austrian government has provided for an experiment station for the culture and preparation of flax in connection with the agricultural school at Trautenau. Dr. Ludwig Langer is director.

KIEL EXPERIMENT STATION.—The annual report of this station (abs. in *Molk. Ztg. 7, No. 35, p. 479*) contains an account of butter-making with pasteurized cream, experiments on the "beet" taste of butter, and observations on bacteria producing rennet and peptonizing ferments. Butter made from pasteurized cream was remarkable for its excellent keeping qualities. It was found difficult in practice, however, to make butter from pasteurized cream without imparting a "cooked" taste to the butter. Better results were obtained when the milk was pasteurized before it was separated, although the results obtained in this way were not entirely satisfactory.

In an attempt made at a creamery to preserve butter in brine, it was found that butter which was not placed in brine acquired a "root" taste. Believing this to be due to the action of bacteria the samples of butter were carefully examined and the different kinds of bacteria isolated. One kind of bacteria found produced an odor and taste in milk similar to that of roots. Butter was made with the use of this bacteria, and it was found that after about two weeks the butter acquired the root taste mentioned above, and this peculiarity increased as the butter aged.

Studies were made of the action of rennet-producing and peptonizing bacteria in the ripening of cheese. Gouda cheese was made using a culture of this bacteria. Instead of having the taste of Gouda cheese, it resembled Wilstermarsch cheese so closely that it was pronounced such by experts. The belief is stated that the characteristic taste and odor and, in fact, the general character of cheese is usually due to one or two kinds of bacteria. The other forms of bacteria present have only an incidental action and have nothing to do with determining the general character and quality of the cheese. It is not assumed that the characteristic qualities of a particular kind of cheese are always produced by the same kind of bacteria; in fact, it has been found that the different kinds of bacteria working in the same media may produce a like result.

INOCULATION AGAINST ANTHRAX.—Protective inoculation against anthrax, by means of the Pasteur method, has been practiced in Hungary for several years. The figures given by Hutyra (*Jahresbericht Veterinärwesen;* (abs. in *Landw. Centbl. Posen, 21 (1893), No. 29, p. 181*) show the extent of its use and the results.

In 1891 the Pasteur-Chamberland laboratory supplied inoculating material for 2,828 horses, 36,457 cattle, and 274,811 hogs.

The total loss by anthrax of horses inoculated was, in the course of a year after the first inoculation, only 0.28 per cent. Of cattle inoculated from 1889 to 1891 only 0.28 per cent died of anthrax. With sheep the loss after the first inoculation was 0.7 per cent, after the second inoculation 0.65 per cent, and subsequently 1.01 per cent.

With hogs inoculated against "rothlauf" the loss after the first inoculation was 0.17 per cent, after the second 0.16 per cent, and subsequently 0.89 per cent.

Taking account of the 312,597 animals inoculated and controlled from 1889 to 1891, the loss from inoculation was 0.35 per cent, and subsequent loss from natural infection 1.2 per cent.

CAPE COLONY.—The following is taken from the *Agricultural Journal*, published by the Department of Agriculture of Cape Colony, through an abstract in *Chemical News (68, No. 1769, p. 197)*:

"The prickly pear, invaluable for fences, but now becoming—both at the Cape and

in Australia—a very troublesome weed, is now being combated with sodium arsenite. We fear that without due care and judgment the remedy may become as bad as the disease.

"The banana crop is now threatened by the 'banana blight,' but spraying with 'Bordeaux broth' (copper and lime) seems to be an effectual remedy.

"The fruit trade seems to have a great future before it. The Union and Castle lines of steamers enter thoroughly into the spirit of the trade.

"The name wireworm, generally applied in the old country to the larvæ of certain Elaters so destructive to root crops, is now extended to *Strongylus contortus*, recently known as *Filoria hamata*, which is as dangerous to sheep as the other wireworm is to vegetation.

"The farmers and gardeners are much exercised by the inroads of the spring hare (*Pedetes capensis*), a burrowing species."

INDIA.—The annual report of the Khándesh Experimental Farm for the year ending March 31, 1892, contains a note on a vegetable parasite belonging to the natural order *Scrophularineæ*, and called in India, tavli and agio. In that country it causes serious injury to sugar cane, sorghum, and rape. It is also found in grass lands. The common belief is that it is worse on fields manured with horse manure, due to the fact that horses are fed on grass which contains the seed of the parasite.

A field of sorghum, attacked by tavli, shows a very uneven growth of the crop, and the plants affected have a pale color.

The seed of this parasite germinates in August or September. It may be destroyed by frequent use of the harrow up to the beginning of November.

The same report also contains a note as to the effect of copper sulphate on smut. On a field of sorghum, the seed of which had been treated with copper sulphate at the rate of one half ounce for the seed used on one acre, there was no smut. An adjoining field, the seed for which was simply washed in cold water, was full of smutty grain.

THE WHEY TEST FOR DETECTING ADULTERATION OF MILK, ETC.—In an article in *Journal of the American Chemical Society* (*vol. 15, No. 6*,) entitled "Milk, skim milk, and whey: A study of their comparative composition and specific gravity," C. B. Cochran reports results of a comparative study of the specific gravity and composition of milk, skim milk, and cream, and the whey from the same. One object of this study was to obtain data for determining the effects of each per cent of casein on the specific gravity of milk and the density of casein in solution.

"The method of work was as follows: Having determined by analysis the total solids, fat, solids-not-fat, and specific gravity of a sample of skim milk, a few drops of a strong solution of rennet, or acetic acid, was added to about 1 pint of the milk in a flask which was then tightly corked and stood on a water bath until coagulation had occurred and a clear whey separated.

"After thorough cooling the whey was filtered, and if clear, the total solids and specific gravity determined. The difference between the total solids of the whey and the solids-not-fat of the skim milk was taken to represent the casein removed. Dividing the difference in specific gravity between skim milk and whey by per cent of casein removed, the quotient represents the loss of specific gravity due to removal of 1 per cent casein. The density of casein in solution is now found by the formula $D-D'=\frac{1-x}{100\,x}$; D=specific gravity of whey; D′=specific gravity of skim milk, minus all fat; x=effect of 1 per cent curd on density. * * *

"The average of these results shows that each per cent of casein removed lowers the gravity of the solution 2.72 degrees, and that the density of the casein in solution is 1.376. * * *

"Having determined specific gravity and total solids of a large number of samples of whey, I conclude that when the coagulation is properly performed under

similar conditions, the specific gravity and total solids of whey of pure milk will vary within quite narrow limits. I find the specific gravity to be 1.027 or higher, and in all but one case as low as 1.0285. The total solids vary between 6.5 per cent and 6.9 per cent. If a sample of whey be reheated further coagulation will take place. In this way the specific gravity of a whey was reduced from 1.028 to 1.0266.

"A milk that had been allowed to decompose for a period of twenty days furnished a whey that had a specific gravity of 1.0255. The whey had an acidity corresponding to 0.76 per cent of lactic acid. The lowering of the specific gravity was a natural result of the fermentation.

"If the number representing the specific gravity of the whey above 1,000 be divided by 4.25, the quotient represents fairly well the per cent of total solids contained in the whey. For example, a whey 1.028 specific gravity will contain $28 \div 4.25 = 6.59$ per cent total solids.

"As might be expected, I find the whey of any given milk has the same composition, no matter whether it is taken from the original milk, the cream, or skim milk. This being the case, a knowledge of the variation in specific gravity and composition of whey of pure milk may be of value in determining adulteration, especially when the milk comes into the hands of the analyst in a churned or soured condition. It is also equally valuable in testing cream for added water."

NOTES ON AMMONIUM-CITRATE SOLUBILITY OF WATER-INSOLUBLE PHOSPHATES AND UPON THE CONVERSION OF HYDROUS PHOSPHATES OF ALUMINA AND IRON.—In a 35-page pamphlet S. L. Goodale gives a critical discussion, with copious references to literature, of the work bearing on these subjects, calling attention to points not well understood, and indicating lines in which further investigation is needed.

AGRICULTURE IN ANGORA.—United States Minister Terrell, Constantinople, forwards a clipping from the Levant *Herald*, published in that city, as showing how primitive are all the methods of agriculture in Angora, and he adds that this is true of all Asiatic Turkey:

" The plowing seasons are in the autumn and spring. The autumn plowing commences as soon as the harvest is gathered in and the soil rendered soft enough by the rains to allow of its being easily turned over or rather scratched. The plow used here by the farmer is constructed out of the branch of a tree. With this primitive implement he merely scratches the surface of the ground. He does not plow enough to disturb the roots of weeds and thistles. Consequently those undesirable intruders flourish gaily in the wheat fields.

"Sowing is generally done at the same time as plowing. In the absence of harrows a branch of a tree takes their place. This is drawn over the surface of the ground. With these primitive implements it will be seen that the seed can not be planted at a uniform depth, and is also imperfectly covered, much to the delight of the feathered tribe. The farmer gets all the seed in the ground he possibly can before the approach of winter. What is left undone stands over till spring.

"Wheat is usually reaped with a scythe or sickle. In cases, however, where the stalk is short it is pulled up by the roots and in this state conveyed to the threshing-floor. It will be easily understood what labor is required to separate the wheat and straw from the roots and soil. The methods adopted for threshing and cleaning are of the most primitive, and cause wasteand loss of time. The wheat (stalks, roots, and ears) is spread out on the ground, and a board studded with sharp flints is drawn over it, round and round, by a pair of oxen. This tedious process is continued until the straw is cut fine enough and the wheat separated from the husk. The cut straw forms the chief food of the live stock during the winter. The wheat, chaff, and dust are then thrown into the air with a large wooden shovel, the wind carrying away the chaff and dust. When the wind necessary for this operation fails, the farmer quietly sits down by the heap and patiently waits for a breeze to spring up. The wheat then undergoes a process of hand-riddling; but however carefully this may be done it does not eliminate grit and stones and other foreign substances. In this state it is

put on the market. The grain merchants who may buy for the Constantinople market have introduced cleaning machines to take out all foreign and worthless substances, thus giving the grain a more presentable appearance and saving freight.

"The absence of modern implements for plowing and sowing, and simple machinery for threshing and for cutting straw, are a great drawback to the farmer. With the aid of such materials he would not be so much at the mercy of the wind and rain.

"Agricultural implements are much needed, such as plows of simple construction, similar in make to the plows now used by the Turkish farmer, but of better construction; also simple threshing machines that could be worked by animal power. * * * Owing to the scarcity of fuel, steam-power machines would be useless. * * * Some plows of German make have been introduced, but they are too heavy to be worked by the oxen employed here."

PERSONAL.—Dr. Joseph H. Gilbert, in recognition of his eminent chemical and experimental work, has had the honor of knighthood conferred upon him by the Queen of England.

RECENT ARTICLES BY STATION WORKERS.—Station botanists have recently contributed to botanical publications the following articles: In *Torrey Bulletin* (*vol. XX*), Southern botanists, F. Lamson-Scribner, p. 315; Symbiosis in roots of *Ophioglossaceæ*, G. F. Atkinson, p. 356; Crossing of cucurbits, L. H. Pammel, p. 350; Photography as an instrument for recording characters of microörganisms in artificial cultures, G. F. Atkinson, p. 357; Dropsical pelargoniums, B. D. Halsted, p. 391; Unequal segmentation and its significance in the primary division of the embryo of ferns, G. F. Atkinson, p. 405; Two perfectly developed embryos on a single prothallium of *Adiantum cuneatum*, G. F. Atkinson, p. 407.

In the *Botanical Gazette* (*vol. XVIII*), Botany at the World's Fair, J. C. Arthur, p. 357.

Notes are given by J. B. Smith, of the New Jersey Station, in *Garden* and *Forest* (*vol. VI, p. 423*), on the occurrence, life history, and methods of combating blister beetles.

CONVENTIONS OF GERMAN SCIENTISTS.—The sixth convention of the Association of German Agricultural Experiment Stations was held at Würzburg, September 8 to 10.

The sixty-fifth convention of the Association of German Naturalists and Physicians was held at Nuremberg, September 11 to 15.

The Association of German Apothecaries held its twenty-second general convention at Frankfurt-on-the-Main, September 6 and 7.

LIST OF PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE.

OCTOBER, 1893.

DIVISION OF BOTANY:

Contributions from the U. S. National Herbarium, vol. I, No. 8, October 31, 1893.

DIVISION OF ORNITHOLOGY AND MAMMALOGY:

Bulletin No. 4.—The Prairie Ground Squirrels or Spermophiles of the Mississippi Valley.

WEATHER BUREAU:

Monthly Weather Review, August, 1893.

OFFICE OF EXPERIMENT STATIONS:

Bulletin No. 17.—Suggestions for the Establishment of Food Laboratories.

DIVISION OF STATISTICS:

Report No. 109 (new series), October, 1893.—Report of the Statistician.

LIST OF STATION PUBLICATIONS RECEIVED BY THE OFFICE OF EXPERIMENT STATIONS.

OCTOBER, 1893.

ARKANSAS AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 24, July, 1893.—Fodder.

CONNECTICUT AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 116, October, 1893.—Fertilizers and Fertilizer Laws.

DELAWARE COLLEGE AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 20.—Anthrax—Precautions Necessary to Prevent its Spread.

Bulletin No. 21, September, 1893.—Insects Injurious to Stored Grain.

AGRICULTURAL EXPERIMENT STATION OF THE UNIVERSITY OF ILLINOIS:

Bulletin No. 26, May, 1893.—The Forest Tree Plantation.

Bulletin No. 27, September, 1893.—Some new Points in the Manipulation of the Babcock Milk Test.

MAINE STATE COLLEGE AGRICULTURAL EXPERIMENT STATION:

Annual Report for 1892.

HATCH EXPERIMENT STATION OF THE MASSACHUSETTS AGRICULTURAL COLLEGE:

Meteorological Bulletin No. 57, September, 1893.

AGRICULTURAL EXPERIMENT STATION OF NEBRASKA:

Bulletin No. 28, March 1, 1893.—Southern Cattle Plague (Texas Fever).

NEW JERSEY AGRICULTURAL EXPERIMENT STATIONS:

Bulletin No. 94, July 2, 1893.—Insects Injurious to Cucurbs.

Bulletin No. 95, September 11, 1893.—The Periodical Cicada.

CORNELL UNIVERSITY AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 56, August, 1893.—The Production of Manure.

Bulletin No. 57, September, 1893.—Raspberries and Blackberries.

NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 92*b*, September 20, 1893.—Meteorological Summary for North Carolina, August, 1893.

RHODE ISLAND AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 25, September, 1893.—Turkeys.

TENNESSEE AGRICULTURAL EXPERIMENT STATION:

Bulletin vol. VI, No. 2, April, 1893.—The Rational Use of Feeding Stuffs; Winter Dairying in Tennessee.

DOMINION OF CANADA.

DEPARTMENT OF AGRICULTURE:

Bulletin No. 19, September, 1893.—Grasses—Their Uses and Composition.

BUREAU OF INDUSTRIES, TORONTO, ONTARIO:

Annual Report for 1892, parts I, II, and III.

PUBLICATIONS OF THE OFFICE OF EXPERIMENT STATIONS.

The Office of Experiment Stations issues three classes of publications for general listribution:

(1) Experiment Station Record, and (2) Bulletins, and Miscellaneous Bulletins, which are more or less technical. It is the practice to send to persons applying for them one or more numbers, from which they may judge of their usefulness, but not to place any names upon the mailing list until after receipt of applications on special blanks furnished by the Office.

(3) Farmers' Bulletins, which are brief and popular in character, and are sent on application. These bulletins are issued as part of the general series of Farmers' Bulletins of the Department of Agriculture.

The following publications have been issued:

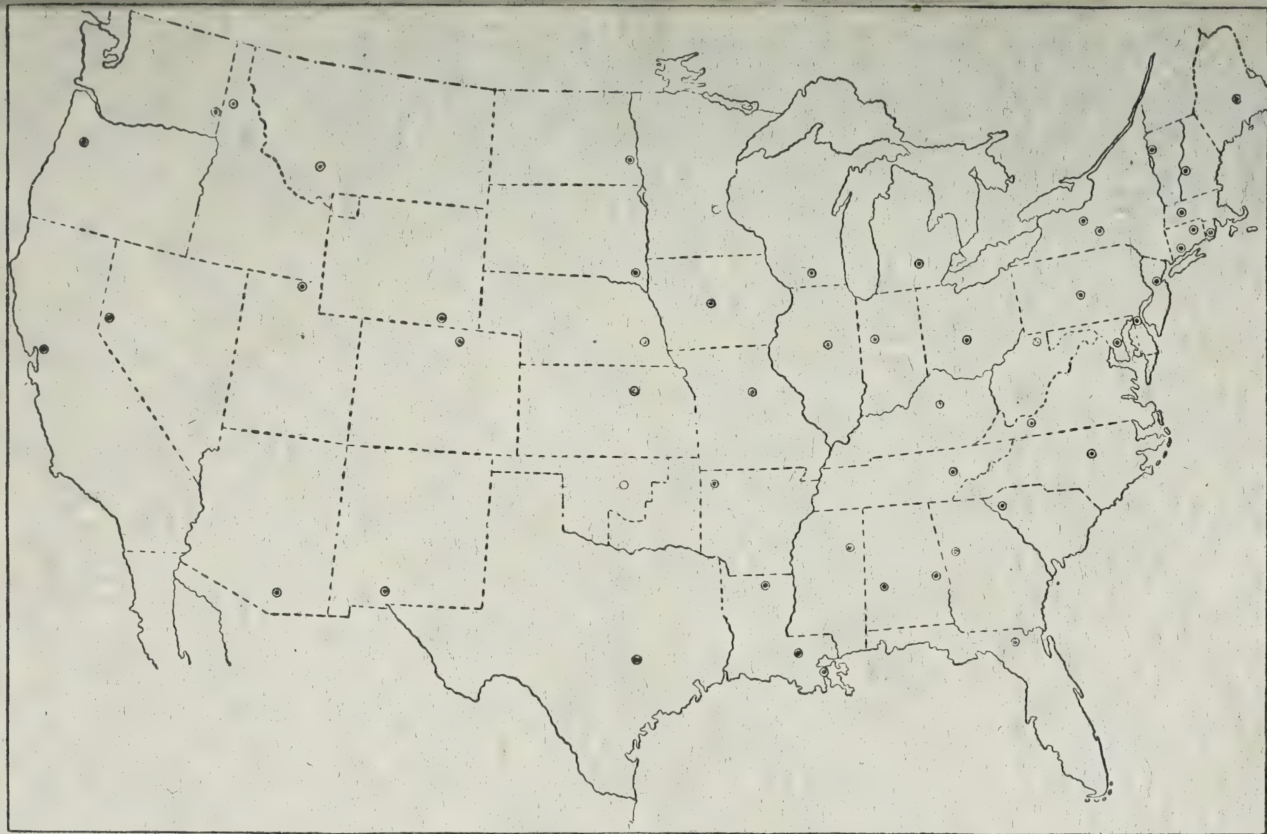
Experiment Station Record, vol. I, 6 numbers; vol. II, 12 numbers; vol. III, 12 numbers and index; vol. IV, 12 numbers, including index; vol. V, Nos. 1 and 2. Copies of the station and Department publications abstracted in the Record can, in many instances, be obtained on application.

Bulletins.—No. 1, Organization and History of the Stations; No. 2, Digest of Annual Reports of the Stations for 1888, in two parts; No. 3, Report of Meeting of Horticulturists at Columbus, Ohio, June, 1889; No. 4, List of Station Horticulturists and Outline of their Work; No. 5, Organization Lists of Stations and Colleges, March, 1890; No. 6, List of Station Botanists and Outline of their Work; No. 7, Proceedings of the Fifth Annual Convention of the Association of American Agricultural Colleges and Experiment Stations, Washington, D. C., August, 1891, No. 8, Lectures on Investigations at Rothamsted Experimental Station; No. 9, The Fermentations of Milk; No. 10, Meteorological Work for Agricultural Institutions; No. 11, A Compilation of Analyses of American Feeding Stuffs; No. 12, Organization Lists of the Agricultural Experiment Stations and Agricultural Schools and Colleges in the United States, June, 1892; No. 13, Organization Lists of the Agricultural Experiment Stations and Agricultural Schools and Colleges in the United States, April, 1893; No. 14, Proceedings of a Convention of the National League for Good Roads, January, 1893; No. 15, Handbook of Experiment Station Work; No. 16, Proceedings of the Sixth Annual Convention of the Association of American Agricultural Colleges and Experiment Stations, New Orleans, Louisiana. November, 1892; No. 17, Suggestions for the Establishment of Food Laboratories.

Miscellaneous Bulletins.—No. 1, Proceedings of Knoxville Convention of Association of Agricultural Colleges and Stations, January, 1889; No. 2, Proceedings of Washington Convention of the Association, November, 1889; No. 3, Proceedings of Champaign Convention of the Association, November, 1890.

Farmers' Bulletins.—No. 1, The What and Why of Agricultural Experiment Stations; No. 2, Illustrations of the Work of the Stations; No. 9, Milk Fermentations and their Relation to Dairying; No. 11, The Rape Plant.

Communications intended for this Office should be addressed to the SECRETARY OF AGRICULTURE, for the *Office of Experiment Stations, Department of Agriculture, Washington, D. C.*


The Agricultural Experiment Stations in the United States.

R. Kent Beattie

U. S. DEPARTMENT OF AGRICULTURE

OFFICE OF EXPERIMENT STATIONS

Vol. V. No. 4.

EXPERIMENT STATION

RECORD

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WASHINGTON
GOVERNMENT PRINTING OFFICE
1894

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U. S. DEPARTMENT OF AGRICULTURE

OFFICE OF EXPERIMENT STATIONS

Vol. V. No. 4.

EXPERIMENT STATION

RECORD

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SEEDS—WEEDS.

DISEASES OF PLANTS.

ENTOMOLOGY.

FOODS—ANIMAL PRODUCTION.

VETERINARY SCIENCE AND PRACTICE.

DAIRYING.

TECHNOLOGY—AGRICULTURAL ENGINEERING.

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EXPERIMENT STATION RECORD.

VOL. V. NO. 4.

The account of the agricultural experiment station at Halle, Germany, published in the present number of the Record (p. 363), has been condensed from an illustrated monograph* containing a somewhat detailed description of the equipment and methods of work of this station, recently issued at Berlin. The monograph was prepared at the suggestion of this Office, under the superintendence of Prof. Maercker, director of the station, by two of his assistants, Dr. K. Bieler and Dr. W. Schneidewind. The volume aims to give such a view of the internal workings as well as the external appearance of the station as may, as far as possible, take the place of a personal inspection of a typical German experiment station of its class. As the methods of chemical analysis employed at the Halle station are essentially those adopted by the Association of German Experiment Stations, the opportunity has been used to compile these methods, as well as to state the peculiar features introduced and used at the station. The latter will be described in a future number of the Record.

But other station workers besides chemists will find much to interest them in this account of the Halle station. Those who are engaged in experiments with reference to the needs of soils and the action of fertilizers will find the description of the vegetation station worthy of study. The feeding experiments in which the stations and the farmers of the province are coöperating will offer many useful suggestions. The coöperative field tests with sugar beets illustrate one of the important ways by which this industry has been enabled to attain noteworthy development in Germany.

The history of the station, its organization, and the way in which it has developed into its present form offer lessons of value to those who are responsible for the management of our stations. The Halle station is the organ of an association of farmers. Most of its income comes from examinations of fertilizers, feeding stuffs, and seeds. The receipts from these sources exceed the cost of the work and the gain is avail-

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*Die agrikultur-chemische Versuchsstation Halle a. S., ihre Einrichtung und Thätigkeit, pp. 147, figs. 27. Berlin: Paul Parey.

able for experimental inquiries, for which small sums are also provided by the Government and other agencies. Of course such large fees from fertilizer, feeding stuff, and seed control would be possible only in a region like the province of Saxony, where the circumstances are unusually favorable.

The station stands in the closest possible relations with the farmers of the province. Its duty is to investigate questions of immediate practical importance for them. It was established in the country upon a farm which offered remarkably good facilities for experimental work; but experience showed that it could do its work better in a city. Here it is accessible to its constituency and has close at hand the means of communication and the experts whose services are so materially needed. Being near a university, it enjoys the benefits of its libraries and laboratories, and has constant contact with specialists in many branches of science. It has been found that the field experiments can best be made on good farms by intelligent farmers, working under the direction of the station and with the help of its experts. As the years have brought increased experience the need of abstract inquiry has become more and more felt, but at the same time the ways of working with the farmers as well as for them have become better understood, so that while the work of the laboratory and the greenhouse have increased the farm experiments are not neglected, but made constantly better. All this is made more practicable and successful by the fact that many of the farmers of the province have large estates, with the best appliances, and not a few of them have, as students in the agricultural institute of the university, learned the fundamental principles of farm science and understand the true functions of farm experimenting. The station is fortunate in its location, its constituency, its experience, and its resources. Its staff of workers has the advantage of long training, excellent facilities for their work, and abundant association with fellow-specialists. The director is happy in having constituents who are able to appreciate the work of the station. Among them are his former students, who, with other capable and intelligent men, are ready to join in coöperative experiments.

Under the title *Lehrbuch der Milchwirtschaft*,* Prof. W. Fleischmann makes a valuable addition to the literature of dairying. Since the publication of Kirchner's *Handbuch der Milchwirtschaft*, the last edition of which appeared in 1886, no book so comprehensive in its nature has been published on this subject. Coming from so eminent an authority as Prof. Fleischmann, the book will be welcomed by all readers of German who have felt the need of a reliable, systematic text-book on the scientific and practical sides of dairying, which should be thoroughly up to date.

The book was written at the request of the German Dairy Association as a text-book for use in the theoretical instruction in dairying in

*Bremen: M. Heinsius Nachfolger, 1893. Price, bound, 8 marks.

dairy schools and higher agricultural schools, and for self-instruction. The author found it necessary to review the entire literature of the subject, and was occupied for more than three years in the preparation of the book. Besides the digested statements in ordinary type, detailed discussions are given in smaller type, and a very large number of references to original articles in footnotes.

In scope the work is broad, as will be seen from the table of contents, which is as follows: (1) Introduction; (2) historical; (3) milk, its secretion, composition, and general properties; (4) milking, handling of milk, and milk testing; (5) milk in its relation to lower organisms—bacteriology in dairying; (6) butter-making; (7) cheese-making; (8) sterilized and pasteurized milk, koumiss, etc.; (9) management of coöperative creameries; (10) margarin and margarin cheese; (11) steam engines; (12) reference tables. The volume contains 356 pages, and is illustrated by 65 figures and 3 plates. The longest chapters are two on butter-making and cheese-making, which include 85 and 76 pages, respectively.

This book is so excellent a manual on dairying that, if translated into English, it would fill a much felt want as a text-book for our agricultural schools, colleges, and dairy schools, and for general reference. Its moderate price places it within the easy reach of all.

Following the example of other civilized countries, Japan is to have a system of agricultural experiment stations established under governmental aid. Since 1877 an agricultural-chemical laboratory has flourished in connection with the Imperial College of Agriculture at Tokio. Until 1881 this was under the directorship of Prof. E. Kirch, at present professor at Cirencester, England, and from 1881 to 1892 it was presided over by Prof. O. Kellner, at present director of the agricultural experiment station at Möckern. Prof. Kellner's place was taken by Dr. O. Loew, formerly of Munich.

The agronomic section of the Imperial Geological Survey, with its laboratory for soil analysis, presided over since 1882 by Dr. M. Fesca, has done useful work for the benefit of agriculture. For many years these institutions have carried on investigations in the field and in the laboratory which have been closely followed in this country and in Europe. Their service to agriculture has been recognized by Japanese agriculturists, and they have created an interest in agricultural experimentation, out of which grew the agricultural-chemical institutes at Yokkaichi and Kyoto.

It was previously noted* that the establishment of agricultural experiment stations was being urged before the newly established Parliament and that information on the experiment station enterprise of this country had been solicited. At the last session a bill for the establishment of experiment stations was introduced and passed without

*E. S. R., vol. II, p. 313.

difficulty, and has since been approved. This act provides for the establishment of seven experiment stations under the control of the Department of Agriculture and Commerce. These are to consist of (1) a central station at Tokio, for the use of which a large farm is available, and (2) six branch stations, to be uniformly distributed over the principal agricultural sections. These branch stations have been located at Kumanato, on Kyushyu; Tokushima, on Shikoku; and at Kiroshima, Osaka, Ishikawa, and Sendai, on the four principal islands. The central station is to be under the directorship of J. Sawano, who was for many years an assistant to Prof. Kellner. The directors of the branch stations are former students of Prof. Kellner and Dr. Fesca. For the support of these stations 30,000 yen (about $30,000) per year is appropriated.

In proportion to the area of Japan, this number of experiment stations is much larger than in this country, since it provides one station to every 22,200 square miles, while in the United States there is one to every 74,000 square miles; but in proportion to the present population it is less liberal than in the United States.

This act of the people of Japan marks one more step in their rapid advancement and will be followed with much interest by students in agriculture in other countries. The results of more general scientific interest will probably be printed in the English language, as heretofore. Since the climatic conditions of Japan correspond to those of considerable portions of the United States we may expect to find in their investigations much that is of interest to us in this country.

THE AGRICULTURAL EXPERIMENT STATION AT HALLE, GERMANY.

The Agricultural-chemical Experiment Station at Halle, in the province of Saxony, Prussia, is the largest and one of the oldest in Germany. It was founded in the year 1855 on a farm at Gross-Kmehlen, and rendered useful service, with Dr. Scheven as director, until 1859, when it was removed to Salzmünde, some eight miles from Halle, and established on a farm long celebrated for its advanced and successful management. The work of the station there, under the direction of Dr. H. Grouven, made it widely and favorably known. In 1865 it was transferred to Halle, where the greater accessibility to its constituency and the connection into which it was brought with the university materially increased its usefulness. Prof. F. Stohmann became its director, and under his administration it continued to grow in public appreciation. On his call to the superintendence of the Institute of Animal Physiology of the University of Leipsic in 1871, the present director, Prof. M. Maercker, assumed charge of the station. Since then its growth has been such that it now has a working force of 26 persons, buildings of its own that have cost, with fittings, more than $68,000, and an annual income of over $16,000. In 1889 a branch of the station was established at Magdeburg to better meet the demand for analysis of fertilizers and feeding stuffs, and for other work in that locality. In 1890 special provisions for investigations in plant culture were made at Halle. The station makes annually chemical analyses and botanical and other examinations of nearly 10,000 samples of soils, seeds, fertilizers, feeding stuffs, and other materials sent to the station for examination or produced in its experiments. It conducts a great variety of chemical, botanical, and other researches in its laboratory, vegetation house, and experimental garden. It supervises a large number of practical experiments on the effects of fertilizers, the cultivation and improvement of the sugar beet, the utilization of feeding stuffs, and the feeding of stock on farms in different parts of the province. While it holds the most intimate relations with the farmers in whose interest it works, it enjoys the full advantages of the associations and appliances of the university in which its director is professor.

The majority of the German experiment stations are devoted more or less to specialties. Some, like the "control" stations at Göttingen, Eldena, and Hohenheim, busy themselves mainly with examinations of commercial fertilizers, feeding stuffs, seeds, or other products of which the purchaser needs to know the character and value. Others carry on special inquiries regarding the more abstruse laws of plant nutrition and growth, by experiments such as those in water culture by Prof. Nobbe at Tharand or those in sand culture by Prof. Hellriegel at Bernburg. It is the chief occupation of other stations to study the more direct applications of those laws to practice, as is done in the experiments of Prof. Wagner, in Darmstadt, with soils in pots and boxes. Others are devoted to researches in animal nutrition, or to experiments upon the effects of feeding stuffs, of which those with the respiration apparatus by Prof. Henneberg and his associates at Wende and Göttingen, and by Prof. Kühn at Moeckern, and those of Kühn on the feeding of milch cows, are examples. At other stations investigations are conducted in behalf of the dairy industry, as is the case with the station at Königsberg, of which Prof. Fleischmann is director. A few stations study the diseases of plants, as is done in the station for investigations of nematodes lately established in connection with the Agricultural Institute of the University of Halle.

The agricultural chemical station at Halle, with its abundant resources and large and appreciative constituency, covers a broader field, and may be taken as a representative of the class of stations which are engaged in the direct application of science, especially chemistry, to the study of problems of immediate practical interest to the farmer.

EQUIPMENT, STAFF, AND WORK OF THE STATION.

The equipment of the Halle station includes, (1) a building centrally located in the city, furnished with needed appliances, and serving for laboratories, offices, and dwellings for the director and other members of the working force; (2) a vegetation house and garden for plant-culture experiments, in the outskirts of the city, with a piece of land adjoining which is rented and used for plat experiments; and (3) the equipment of the branch station at Magdeburg.

The working force of the station at Halle consists of a director, vice-director, 10 assistant chemists, 2 botanists, 1 secretary, 1 accountant, 2 gardeners, and 5 servants; in all, 23. These, with 3 persons connected with the Magdeburg station, make a total staff of 26.

The principal lines of work followed by the station are:

(1) Analyses of fertilizers and feeding stuffs, studies of methods of analysis, and other chemical investigations.

(2) Botanical investigations, including examinations of seeds.

(3) Inquiries in agricultural technology, especially in sugar and alcohol manufacture, which are important industries in the region.

(4) Feeding experiments with cows, oxen, and sheep on farms in different parts of the province.

(5) Field experiments with different fertilizers and crops, especially the sugar beet, on farms in different parts of the province.

(6) Pot and plat experiments upon the growth and nutrition of plants in the vegetation house and grounds of the station.

The number of samples of different materials of which chemical analyses or botanical or other tests were made for four years, as shown in the following tables, will give a further idea of the activity of the station.

Number of samples of different materials analyzed and otherwise examined by the Halle station, 1888-91.

	1888.	1889.	1890.	1891.
At the Halle station.				
Fertilizers, soils, etc	2, 667	3, 067	3, 223	3, 495
Feeding stuffs and sugar beets	895	1, 094	1, 147	1, 301
Seeds and other materials tested botanically	502	656	966	1, 146
Soils (for phosphoric acid)	....	....	303	141
Grains, variety tests	155	436	200	....
Feeding stuffs used in feeding experiments	712	918	661	125
Sugar beets from field experiments	442	144	6	391
Products from plant-culture station	....	....	313	713
Total	5, 368	6, 216	6, 819	7, 311
At the Magdeburg branch station.				
Fertilizers	....	....	397	407
Feeding stuffs and milk	....	....	1, 924	2, 137
Total	....	....	2, 321	2, 544
Grand total	5, 368	6, 216	9, 140	9, 855

The revenue of the station for 1891 amounted to $16,250 (65,000 marks), $2,250 of which were received from the general (Prussian) government, $750 from the provincial government, $10,000 from the receipts for analyses and other investigations of fertilizers, feeding stuffs, seed, etc., $2,500 from the fertilizer control, and $750 from various other sources. The receipts for 1892 were larger, so as to warrant expenditures as follows:

Salaries, etc	$6, 833. 25
Laboratory and other running expenses	3, 363. 94
Furnishings, etc	520. 88
Maintenance and repair of buildings	796. 24
Experiments	4, 402. 66
Other expenses	1, 499. 60
Total	17, 416. 57

SPECIAL FEATURES OF THE STATION AND ITS WORK.

Some of the special features of the station and its work deserve a word of comment before proceeding to the more detailed description.

The Halle station is the organ of a large and powerful agricultural society, in a region where extensive farming is practiced, where many farmers have large capital invested in their business, and where agricultural science and education are well developed. For years agricultural schools and experiment stations have been in successful operation in that locality. The agricultural institute of the university has long ranked with the schools of medicine, law, and theology, and the men who have followed its courses of instruction are numerous in the province. There is a well-organized system of agricultural societies, united in the central society, of which the Halle station has for some thirty years been the special scientific agency.

Examinations and control of fertilizers, feeding stuffs, and seeds.—One of the chief functions of the station is the so-called control of these materials by chemical analysis and botanical tests. The methods of investigation used in the tests are largely those employed by the German experiment stations generally. Special features of these methods, introduced by the Halle station, will be described in a future article.

It has long been the practice of many German stations to make especial arrangements with manufacturers and sellers of fertilizers whereby the composition of the goods sold in the region is guaranteed, and the buyers have the privilege of having the goods analyzed at the station and receive a rebate if the percentages of valuable ingredients fall below the guaranties. In many instances the dealers agree to pay the whole of the expense of the analyses. In other cases, part or all of the expenses is borne by agricultural societies or by individual purchasers. Similar arrangements are made by stations for tests and guaranties of feeding stuffs and of seeds. In former years the Halle experiment station had very extensive contracts with manufacturers and dealers in fertilizers for the exercise of the control in this way. Of late, however, the policy in this respect has changed, and now control of fertilizers, feeding stuffs, and seeds, as such, is practically given up. There are no arrangements between the station and dealers, and no contracts will be made with them in the future. It has become the usage of farmers to unite in the purchase of their materials, and to have them analyzed at the station. Before the farmers had got so far as to have all of their materials analyzed on their own account there was a demand for a fertilizer control. This, however, is no longer the case. Buyers purchase the wares on guaranty and have them tested by the station. The costs of the examination are paid by the person sending the materials to the station for examination, whether he be farmer or dealer. The station has a

regular tariff of prices, uniform in all cases, the only exception being that where large amounts of work are done regular discounts are made. The prices charged are illustrated by the following selections from the published tariff of the stations:

Prices charged for analyses and other tests by the Halle station.

(1) FERTILIZERS.

Phosphoric acid:	
Soluble, determined by uranium	$1.50
Determined by molybdic method	2.50
Soluble and total together	3.75
Soluble in citrate	2.50
Nitrogen:	
By Kjeldahl method	1.50
By Dumas method	5.00
In Chile saltpeter	1.50
Potash, lime, magnesia, each	1.50
Thomas slag:	
Phosphoric acid and fine powder	2.00
Redonda phosphate as impurity, qualitative	0.75
Redonda phosphate as impurity, quantitative	3.00
Marls for carbonate of lime (Scheibler's method)	0.75
Soils for nitrogen, potash, lime, phosphoric acid, humus, mechanical condition, each determination	1.50

(2) FEEDING STUFFS.

Feeding stuffs:	For dealers.	For farmers.
Complete analysis	$5.00	$3.75
Moisture, fat and protein	3.00	2.50
Digestibility, Stutzer's method	5.00	3.75
Milk, dry substance, and fat by Soxhlet's method	1.50	1.50

(3) SEEDS, ETC.—BOTANICAL EXAMINATION.

Germinating power—	
In fodder and sugar beets	$2.50
In cereals, clover, legumes, onions, etc	0.75
In grasses and carrots	1.25
In *Agrostis* spp	1.50–2.50
In conifers	1.50
Specification of impurities in specimens of seeds	1.25–6.25
Dodder in clover and lucern	0.75
Dodder in white and alsike clover	1.25

It is worth noting that the German systems of control differ fundamentally from those in vogue in the United States. They are entirely voluntary, and neither enforced nor aided by legislation. The Government requires no branding of goods, provides no inspection, indeed, does not concern itself with the subject in any way. It is simply a matter between the seller and the buyer in which the station tests the goods for quality and agreement with the seller's guaranty. The arrangement is acceptable to the dealer because it guards him against

unfair or fraudulent competition and secures for him the confidence of his patrons. It is satisfactory to the farmer because it tells him exactly what he is buying and insures him good articles at equitable prices. It is useful to the stations because it gives them a revenue which more than covers the expense of the tests and thus secures them means to carry on other inquiries. The larger part of the income of the Halle station is derived from this source, and with it the station has acquired a valuable property, has put up costly buildings, and carries on extensive investigations in various directions.

The work of the Halle station is mainly practical rather than abstract. It represents the direct application of science to the study of specific problems in farm economy. The justification of this is found in the fact that abstract research is going on all about the station. Close at hand is the University of Halle with its laboratories of applied science. But a few miles away are the University of Leipsic and the experiment stations of Möckern and Bernburg, where abstract inquiry is cultivated. In different institutions in Germany hundreds of the ablest investigators of the time, supplied with the most elaborate apparatus and means for research, are devoting their energies to the discovery of the abstract laws of vegetable and animal production. The farmers of the Prussian province of Saxony are met by certain definite questions, the solution of which is important for their business. The station at Halle takes up these questions, gets what light it can from other sources, studies them from the farmer's standpoint, and obtains results of the highest practical value.

The station has no farmers on its working force because its work is not farming. It has not invested its means in a farm or in farm implements or in stock for the same reason, and because, furthermore, it can avail itself of land and stables and animals on farms in the province, where experiments can be made more profitably than if the station owned them. It has left a location in the country on an excellent farm and taken its permanent abode in a city close to a university because it is thus more accessible to the farmers for whom it is working and has more advantages for its work.

But while the trend of the station is so thoroughly practical, it carries on more or less of purely scientific inquiry, and all its work is done in the most truly scientific ways. The director and his assistants are trained specialists, and had devoted years to special study and research before assuming their places in the station. The assistants are encouraged to prosecute original inquiries, and have not only the advantages of the large resources of the station and the counsel of the director and other specialists, but the stimulus of publication with full credit for authorship when they obtain results of value.

Much attention is paid to the study of methods of analysis and investigation. The station belongs to the Association of German

Agricultural Experiment Stations, has an important share in the elaboration of the methods of chemical analysis adopted by that association, and naturally employs them in the laboratory. In like manner the seed tests are made in accordance with the methods recommended by the conventions of the seed-control stations.

A marked feature of the laboratory work of the Halle station, and one which is common in German laboratories and might with advantage be made much more so in our own, is the employment of a large proportion of janitorial and other comparatively inexpensive service. The working force of the station includes with its 10 chemists and 2 botanists no less than 5 servants who, in addition to the janitorial labors, doing of errands and the like, perform much of the mechanical routine work of analysis. Aside from the pecuniary economy of such inexpensive service it has the very decided advantage of enabling the specialists to give themselves more fully to the higher duties of their profession.

In the actual conduct of its laboratory work the station has taken great pains to systematize the operations so as to turn off the maximum amount with accuracy. Each period of the year has its particular lines of investigation, each laboratory room its special operations, and each man his own peculiar work. The order and system of a large manufacturing establishment are observed in this institution for scientific inquiry.

The Halle station thus represents, in highly developed ways, the union of science with practice; the coöperation of the specialists and the farmers and the use of the latest and best teachings of the higher abstract inquiry in the study of problems of immediate practical importance for the community by which it is supported and in whose interest its labors are performed. The details of its work are carried out in a systematic, business-like, and economical manner. As a result, it renders remarkably useful service to practical agriculture, and contributes not a little to the advancement of science.

THE STATION BUILDING.

On its removal to Halle, the station was first installed in a small house, but in 1875 a building was erected especially for its use, which it has since occupied, although additions and alterations have been made from time to time as the station has grown. The building in its present form has cost about $50,000, exclusive of land, and the internal equipment has cost fully $12,500, making a total of $62,500. Another extensive addition is planned. The vegetation house, which is in the suburbs of the city, was erected at a cost of over $6,000.

The station building is of brick, with a frontage of over 150 feet, and consists of a basement and three stories. The basement contains a dwelling for the janitor, a complete flouring mill and bakery for

testing cereal grains, store rooms, the heating apparatus, a gas engine, grater and press for sugar-beet work, etc.

The ground floor is occupied by the laboratory, the offices of the director and the secretary, and the library. The second floor is used as the dwelling of the director; the third floor contains living rooms for 5 assistants and the office of the Provincial agricultural society. The plan of the laboratory floor is shown in the accompanying illustration (Fig. 1).

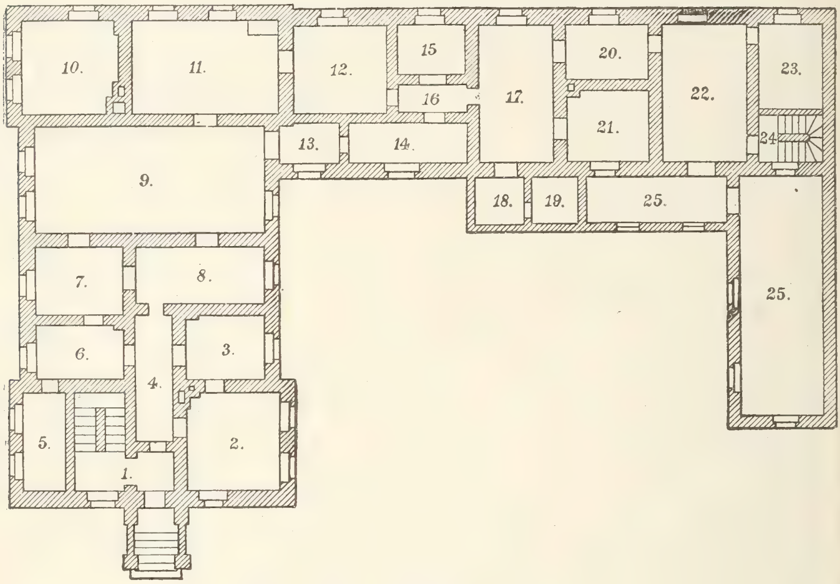

FIG. 1.—Plan of laboratory of Halle station.

1. Hall and staircase. 2. Director's office. 3. Director's private laboratory. 4. Passageway. 5. Library. 6. Office of secretary. 7. Balance room. 8. Room for preparation of samples. 9. Large laboratory room. 10. First assistant's room. 11. Room for general work, 12. Nitrogen room. 13. Phosphoric acid room. 14 and 15. Botanical laboratory. 16. Passageway. 17. Machine room. 18. Anteroom. 19. Ventilated room. 20. Room for drying baths and fat extraction. 21. Room for experiments in alcohol manufacture. 22. Collections. 23. Supply room. 24. Staircase. 25. Room for demonstations, with passageway.

GENERAL ARRANGEMENT OF LABORATORIES.

Opening from the main entrance to the station building, on the first floor, are the offices of the director, the library, with 1,500 volumes (exclusive of those in general use in other rooms by the director and assistants), a room for the secretary and accountant, a room where materials are received, registered, and prepared for analysis, and the private laboratory of the director. Next is a large room (No. 9) for general laboratory work, running the whole width of the building and containing working desks for 8 assistant chemists. In the center of this room is a large working desk with stone top, 4 meters long and $1\frac{1}{2}$ meters wide. The space at this desk allotted to each assistant is 2 meters long by $\frac{3}{4}$ meter wide. It may be mentioned that 3 meters of desk

room to each assistant is considered desirable, but unfortunately the limited room does not admit of this.

Adjoining this is a large balance room, although balances are also placed elsewhere as convenience in weighing calls for them, *e. g.*, in the preparation, nitrogen, and phosphoric-acid rooms and in the botanical laboratory. Then come the private laboratory of the vice-director and another room for general purposes. The latter, room 11, is used for the determination of nitrogen in nitrate of soda, for which an apparatus suitable for twelve simultaneous determinations is set up; the polarization of sugar-beet solutions during the season of sugar-beet experiments; the titration of the acid solutions from the nitrogen room; the washing of glassware; and drying by direct heat. Beyond this is the nitrogen and combustion room (No. 12), with two large hoods against the walls, under which the Kjeldahl digestions are made, a large table in the center for the Kjeldahl distilling apparatus, and large stone-topped tables for combustion furnaces under hoods. Adjoining this are a small room devoted exclusively to phosphoric acid determinations; the botanical laboratories, including a room for seed testing; a room thoroughly ventilated with hoods around the walls for carrying on operations where injurious or unpleasant fumes are given off; and a large room for mechanical operations, containing different styles of mills for grinding samples, the milk separator, etc. The machines in this last room are run by either a water motor (one eighth horse power and driven by the city water) or by a gas engine of two horse power in the cellar. It is in this room principally that the servants work. Room 20 contains the drying closets, of which there are numerous forms, some with automatic temperature regulators, some with direct heat, and others heated by steam. The apparatus for fat determination is also in this room. Twelve Soxhlet extractors are connected with a large cooler and specially protected against fire.

Room 21 is used for investigations in the manufacture of alcohol and contains a complete miniature distillery with the most approved appliances.

Room 22 is a large collection room, containing specimens of interest in connection with the work of the station and other objects of agricultural importance. Among these are a complete collection of all known fertilizing materials and the crude materials used in their manufacture, and a collection of the principal soils of the Province.

Room 25 is used for purposes of demonstration, and opens into a large passageway. In the cellar under room 25 arrangements are to be made for recovering the citric acid and ammonia used in the phosphoric acid determinations. Since several thousand of these determinations are made annually, citric acid and ammonia are among the reagents extensively employed.

EXPERIMENTAL WORK.

In addition to the chemical analyses made in connection with the control of fertilizers, feeding stuffs, etc., above referred to, the methods of which will be described hereafter, the Halle station carries on work in a number of lines which merits especial notice.

EXPERIMENTS WITH CEREAL GRAINS; VARIETY TESTS; WHEAT FOR BAKING.

The characteristics and comparative values of varieties of cereal grains, especially wheat, have formed one of the important subjects of investigation by the station for some time. In this work field tests and laboratory experiments are combined. Of the field tests, a few are made upon small plats of land adjoining the station vegetation house, but the principal stress is laid upon trials conducted on a larger scale by farmers on their own farms, under the direction of the station. The products are examined in the laboratory with reference to the quantity of protein, hardness or glassiness (*Glässigkeit*) versus mealiness of the kernels, weight per hectoliter, size of kernels, and with wheat the proportion of gluten and the baking quality.

The reason why the interior of some grain is glassy, and that of other grain of the same species mealy, is as yet unexplained. Mealy barley is preferred for brewing, because malt from the glassy grain is less soluble and yields less extract in brewing. For examination with reference to glassiness or mealiness an instrument called the farinatom is used.* Along with this are examinations of color, character of the hull, odor, and germinating power (vitality).

The weight per hectoliter is determined by the Schopper hectoliter scales.

The determination of the size of the kernels was formerly made by counting the number of kernels in 10 grams. At present the West felt granometer is used, with which 100 kernels are counted and weighed.

Baking quality of wheat.—The baking quality of wheat is an important matter for the producer as well as for the baker. It could not be learned from the quantity of total nitrogen, nor from that of the albuminoid nitrogen, even if the latter were an exact measure of the albuminoids, because the baking power, *i. e.*, the tenacity of the gluten, depends upon the kinds as well as the total amount of albuminoids present. For the same reason the methods of separating the gluten by washing and kneading with water and measuring its amount can not be accurate.† Nor do the ordinary mechanical tests of the tenacity of the gluten suffice. The method adopted by the international jury at the

*As devised by Brewery Inspector Grobecker-Arten.

†Dammer: Lexicon der Verfälschungen, 1887, p. 545; Landw. Vers. Stat., 31 (1885), p. 184.

late exposition in Vienna, which depends upon the quantity of water which the flour is found to absorb; that of treating the flour with acetic acid to dissolve the gluten and estimating the gluten from the specific gravity of the solution; and various other chemical tests, have all proved unsatisfactory.

The Halle station has therefore adopted the very practical plan of grinding different kinds of wheat, baking bread from the flour, and judging the quality of the grain from the bread produced. To this end a small flouring mill and a bakery have been established in the basement of the station building. Investigations made in this manner have now been going on since 1886.

The grinding is done by a roller process, with machinery brought from Hungary (Buda-Pest) for the purpose. The flour is tested in the following ways: (1) The "moist gluten" is prepared by kneading the dough in a stream of water, 10 grams of flour are moistened with 4.5 grams of water, the dough rolled into a ball in the hands with care to avoid loss, put in a covered porcelain dish and allowed to stand for an hour. It is then placed upon a brass sieve of one half mm. mesh, and kneaded with ice water which has stood for some time over gypsum. The water is allowed to fall upon the dough at the rate of three drops per second. When the gluten is thus sufficiently freed from starch, sugar, amides, and other ingredients of the flour, it is washed in a stream of water until the washings give no further reaction for starch with iodine.

(2) The "dry gluten" is estimated by determining the nitrogen in the moist gluten by the Kjeldahl method and multiplying the amount by 6.

(3) To estimate the total protein the nitrogen of the gluten is subtracted from the total nitrogen of the flour, the remainder is multiplied by 6.25, and the product added to that obtained for the quantity of gluten.

(4) The baking quality of the flour, as already stated, is tested by making bread from it. The important factors for estimating the quality of a given flour are the color and the texture, *i. e.*, the "lightness" of the bread. The latter is expressed in the size or better the volume of a loaf of given weight. For making the bread a baker's oven of the latest and best construction was provided and the different specimens of flour to be tested were baked in the small loaves (*Semmel*) common in the region. Experience showed, however, that the oven did not permit sufficiently accurate control of the conditions of the experiment. Accordingly the method was changed, and arrangements were provided by which the dough is put in brass dishes 7.5 c. m. in height and 6 c. m. in diameter, opening at the top and bottom, but covered at the top while baking. These are placed in a muffle oven heated

by gas and baked thirty minutes at a temperature rising from 215° to 225°.

In the earlier experiments the same quantities of water and of yeast were used for a given quantity of flour in all cases, in accordance with the recommendations of Stutzer. But experiments by Dr. Cluss soon verified the common observation of bakers that different kinds of flour require different proportions of water to make a dough of a given consistency, and that different specimens of yeast differ widely in leavening power, so that different quantities must be used to obtain comparable results. Accordingly the leavening power of the yeast is determined by Hayduck's method* and an appropriate quantity is used.

With each of the different samples of flour tested by baking a parallel test is made of a sample of flour of good quality, which is kept as a standard for the purpose. Four parallel tests are made in each case, three from the sample under consideration and one from the standard flour. For each of these four tests, 105 grams of flour are used. The water added varies from 70 to 100 c. c.; the weight of yeast is usually about 3 grams. The flour is put into a porcelain-lined evaporating dish of known weight. Part of the flour is mixed with the yeast into a soft dough, and this, with the rest of the flour, is kept for one and a half to two hours at 30° in the fermentation chest. This latter is like an ordinary air bath, but has sand on the bottom moistened with water, which gradually evaporates and prevents the dough from drying on the surface and hindering the fermentation. At the end of this first fermentation 1.4 grams of salt are added, the dough mixed with the rest of the flour, kneaded, and placed in the fermentation chest for an hour longer, during which it is kneaded from time to time. The dish and dough are then taken out and weighed, and the dough divided into three equal parts. These are put in the fermentation chest for from one and a half to two hours and then into the baking dishes and baked in the muffle oven. Twelve loaves, all told, are thus made in testing one sample of flour.

To determine the volume of the loaf it is placed in a vessel holding 500 c. c. and enough sand poured in to fill the vessel. The weight of this sand compared with that of 500 c. c. of the same sand suffices for an easy calculation of the volume of the loaf.

FIELD EXPERIMENTS IN SUGAR-BEET CULTURE.

In the remarkable improvement in the sugar beet by breeding and culture in Germany, the Halle station has taken active part. Since 1880 comparative tests of varieties of beets have been made annually on a large scale under its direction by the farmers of the region, which is one of the great centers of the sugar-beet industry.

*Maercker: Handbuch der Spiritusfabrikation, 1890, p. 515; König: Untersuch. der Landw. Stoffe, p. 539.

Aside from the size and form of the beet and the yield, the essential feature is the composition of the juice and the quantity of crytallizable sugar. The effort has been to breed varieties which will best fit the demand of the sugar producers of the region. To this end the seed producers grow their beets, determine the sugar content of the individual beets by analysis, select the best and set them out the next season for producing seed, which they sell. Some of the establishments are very extensive and are managed with the greatest care. They have laboratories of their own in which the sugar content of the beet is tested, and employ a large force of chemists for the purpose.

The method of carrying out the comparative tests of seeds just referred to is briefly as follows: A representative from the station is present at the time of harvesting the seed and takes a sample from a lot of at least several hundred pounds. This sample is sealed and sent to Halle, where, with other samples taken in like manner, it is examined in the botanical laboratory. Each sample is designated by a number, the source, *i. e.*, the name of the producer, being known only to the director and the assistant who took the sample. Some fifteen samples are thus provided for comparative tests each season. Each sample is divided at the proper time into portions for the practical field tests, of which about fifteen are made by farmers. For each practical test a field is selected which is free from nematodes and sufficiently large to give as many five-eighths-acre plats as there are samples of seed to be tested. The land is carefully prepared, and, as in other similar field trials, the cultivation is as uniform as possible. Just before harvesting, the beets on each plat are counted and every hundredth beet is marked with paint. These marked beets are taken as samples by a station assistant and sent by express to the station, where the examinations, including especially the tests of sugar content, are made. The trials are thus in the strictest sense comparative.

The results of the trials are published, showing the percentage of sugar, and the yield of beets and of sugar per acre with details and averages. Photographs are also made of typical specimens of beets so that the morphological changes in the gradual progress of upward breeding may be recorded for future study.

This amounts, therefore, to a coöperative effort of seedsmen, farmers, and the station, not only to secure the best kind of beets each season, but to constantly improve the quality by breeding from the best.

FEEDING EXPERIMENTS.

Among the practical problems in feeding which interest the farmers of the Province are the proportions of nitrogenous and non-nitrogenous materials which can be most advantageously used, and the economical utilization of diffusion residue of sugar beets, and of potato distillery refuse from the manufacture of alcohol.

During a number of years past series of such experiments have been conducted on farms by men especially fitted for the purpose, some of whom have been students at Halle. The experiments have been made with fattening oxen and steers, milch cows, and sheep. The methods and results published previous to January, 1892, have been recapitulated in the Experiment Station Record.*

To secure the greatest practical uniformity, the concentrated feeding stuffs for all the trials of a given series are obtained from a single source and distributed to the experimenters. The coarse fodders are naturally of home production. Samples are taken of these from each farm and analyzed at the station, together with those of the concentrated materials.

The digestibility of the protein of the feeding stuffs is estimated by Stutzer's method. For the fat and nitrogen-free extract Wolff's coefficients are used. The nutritive value of the fat of concentrated feeding stuffs is taken as two and one-half times that of the nitrogen-free extract; but as the ether extract of coarse fodder contains considerable admixtures of other materials than fat, it is only taken as equivalent to the nitrogen-free extract in nutritive value.

In accordance with the older theory that the indigestible non-nitrogenous extract of coarse fodder is nearly equivalent to the digestible crude fiber, the latter is assumed to be wholly indigestible and the former wholly digestible. The ration in each case is calculated on the basis of the percentages of digestible nutrients as thus computed.

The number of animals in each lot in a series of experiments with oxen or cows is generally five or six, and in experiments with sheep, ten, there being as many lots as there are different rations to be tested.

The feeding periods proper in experiments with oxen and sheep are ordinarily one hundred days and are preceded by preliminary periods of ten days. In experiments with milch cows there is likewise a preliminary period of ten days, after which comes three test periods of thirty days each, separated by transition periods of ten days. The rations are usually reversed in different periods, being the same, however, for the first and third periods, to allow for the natural depression in milk production. Formerly ten days were allowed for each of the three test periods, but experience has led to lengthening them to thirty days each. In the preliminary and transition periods the food is the same as that to be fed in the immediately succeeding period.

In all the experiments the animals are weighed at the beginning and end of each period. In the experiments with milch cows samples of the morning and evening milk are taken every third day during each of the test periods and analyzed. For the latter purpose determinations are made of specific gravity and fat, and the total solids are calculated by Fleischmann's formula.

*Vol. III, pp. 507, 557, and 640.

For the estimates of financial results, which are especially sought in these experiments, the factors used are, on the one hand, the values of increase in live weight with fattening animals, the milk produced by cows, the manure, and the change in live weight of cows, and, on the other, the cost of feeding stuffs, housing, and care. From these the balance of profit or loss is calculated.

The value of the manure is estimated from the quantities of valuable fertilizing ingredients (nitrogen, potash, and phosphoric acid) in the food and bedding, making allowance for the amounts consumed in producing milk, meat, or wool. The calculations are facilitated by a system of farm bookkeeping, developed by an expert, and used with his assistance on a number of farms in the region.

The system for conducting the experiments has been elaborated during a series of years. In preparing for a campaign of coöperative trials, a specific, narrow question is decided upon, and the details of the plan are worked out by the station, and farmers invited to join. To those who are interested detailed directions are sent and arrangements are made with a certain number to join. Representatives of the station make personal inspection of the experiments from time to time. Forms for detailed reports are furnished to the experimenters. These reports are filled out and returned to the station where they are worked over, and the outcome of the experiment is published.

As contributions to the theory of animal nutrition these experiments do not compare with the researches of the experimental stall and the respiration apparatus. Even their practical value is limited, for the most part, to a certain set of conditions. But for the farmers who make them and the communities in which they live, their usefulness has been demonstrated in many and most encouraging ways.

During the year 1891* experiments on the value of molasses for feeding formed a prominent part of this branch of the station's work. The recent changes in the tariff on sugar manufacture have rendered the separation of sugar from molasses unprofitable, and consequently lowered the price of beet molasses. It is mentioned that while formerly only small amounts of molasses could be fed with wet sugar-beet residue, the experiments have shown that larger amounts can be fed with the dried beet residue with advantage, and the results point to the feeding of molasses with dried beet residue as a profitable means of utilizing this product.

FIELD EXPERIMENTS WITH FERTILIZERS.

For a long series of years the station has planned practical field experiments with fertilizers which have been carried out by farmers in different parts of the Province. They have had to do with specific questions such as the effects of fertilizers containing nitrogen, phos-

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* Maercker: Bericht der agr. chem. Versuchs station zu Halle, 1891.

phoric acid, or potash in different forms and amounts, upon sugar beets, the sugar content as well as the amount of the yield being taken into account. The results of experiments are applicable chiefly in the region where they were made and there they have had the highest value. At the same time they teach much that is of general interest, and they are a most instructive illustration of the usefulness of such coöperative inquiry.

One result of the experience of the station in field work has been to emphasize the need of investigations in which the conditions can be better controlled and the phenomena can be more accurately studied. This is feasible only in experiments on a small scale. Accordingly it was decided to make special studies of a number of representative soils of the Province by bringing small quantities to Halle and using them, with specimens taken from the neighborhood, in pot experiments. For this purpose a vegetation station was established.

THE VEGETATION STATION.

In 1889, with the aid of a small grant from the Prussian Government, provision was made for experiments on the plan developed so successfully by Prof. Wagner at the station in Darmstadt. For this purpose buildings were erected in one of the suburbs of Halle and a piece of contiguous land was leased.

Vegetation experiments, object.—The general purpose of this vegetation station, as it is called, is to carry out experiments on a small scale, mostly in pots (vegetation cylinders), for the study of the supply of food to plants by soils and fertilizers. For the present a definite and narrow question is proposed. It is, so to speak, the analysis of the soil by the aid of the plant; or, more specifically, to learn what quantities of certain nutritive elements can be assimilated by plants from different kinds of soils. Attention has thus far been confined mainly to the phosphoric acid supply.

The most of the experiments are made with soils in pots arranged on small platform cars which may be kept under cover or moved out into the open air, as occasion requires. A smaller number are made in pots which remain permanently outside. Incidentally a certain number of plat experiments are made on the soil of the adjacent field. One of the chief uses of these plats is to prepare soil for the pot experiments. For the latter it is essential to have soil in which certain ingredients of fertilizers, nitrogen, phosphoric acid, or potash, will act effectively. In the highly cultivated soils of the region the available supply in the soil must often be reduced to fit them for the experiments. To accomplish this incomplete fertilizes, nitrogen and potash, singly or in combination, are applied to the plats and exhausting crops of various kinds are grown upon them from year to year until the supply of the element in question is reduced to the required extent When accumulated stores of the element have thus been removed and the soil has

only its natural and constant supply to rely upon, it is in condition for a fair test of its power to furnish the element to plants grown upon it.

In the investigations on phosphoric acid the specific questions proposed are: (*a*) How large amounts of phosphoric acid can be assimilated by different plants from the same soil? (*b*) Can different soils with like proportions of phosphoric acid supply different amounts to the same kind of plant? If such is the case the phosphoric acid must vary in solubility in different soils. (*c*) With what maximum content of phosphoric acid does the soil cease to react with phosphatic fertilizers; in other words, how much phosphoric acid must the soil have in order to render this ingredient superfluous in manure?

Parallel with the vegetation experiments a series of laboratory investigations are made to compare the quantities of phosphoric acid taken from the soil by the plants with the quantities in certain reagents, as dilute citric acid.

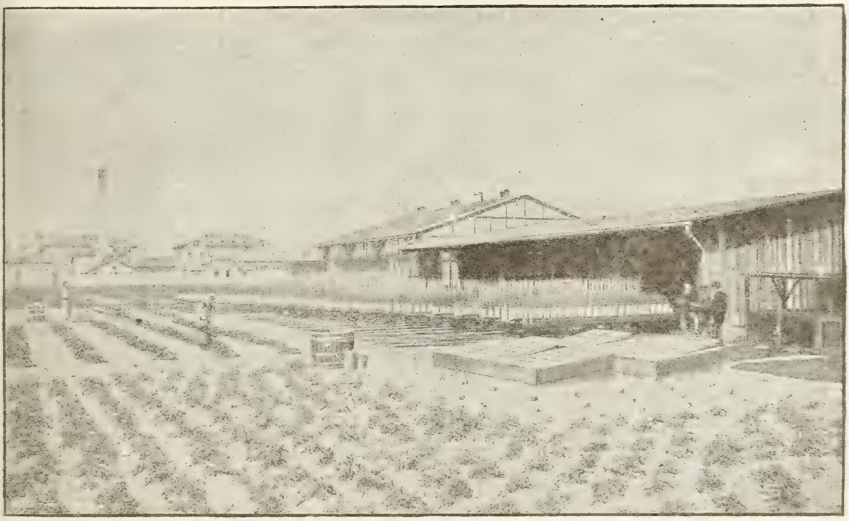

FIG. 2.—Buildings of vegetation station.

Equipment.—The buildings of the vegetation station (Fig. 2) are two, a plant house, partly of glass, and an adjoining shed. There about two and one half acres of land connected with them and available for experimental purposes. The vegetation station is connected with the main station in the city by telephone.

The plant house, or principal building, is of brick, 48 feet long by 33 feet wide, and divided into three apartments. The largest of these occupies the whole of one side and serves as a greenhouse, the ground dimensions being 48 by 17½ feet, and the height from 11 feet in front to 18 feet at the rear. The roof and front are of glass and the front has doors through which the platform cars can be moved out on tracks.

The remaining two rooms occupy the other side of the building. One is 15½ feet square and is used for preparing materials, weighing, etc. The other is 15½ by 32 feet, and serves as storeroom.

The second building is a plain wooden structure adjoining the plant house and serving to protect the plants at night and in bad weather. Its length is 63 feet, width 33 feet, and height from 11 feet in front to 15 feet in the rear. The front is entirely open and a system of tracks leads out into the field in front of the building.

The cars hold 36 vegetation cylinders each. The glass house accommodates 12 cars with 432 pots. In the shed are at present 16 cars with 576 pots, though there is room for 20 cars, thus accommodating 720 pots. The two buildings thus afford protection for 1,152 vegetation pots with plants.

A considerable number of pot experiments is made in vessels standing permanently outside either on frames or in the ground. This, however, is an expedient necessitated by the present lack of room in the houses. Satisfactory results are obtained when the plants are not injured by cold, wind rain, or, what is most to be feared, hail.

The plat experiments stand midway between the vegetation experiments in pots and ordinary field experiments.

Conduct of pot experiments.—The pot experiments are made with natural soils in zinc cylinders. In order to secure soils fitted for the study of the questions relating to phosphoric acid, several hundred samples were brought from different parts of the province and examined in the chemical laboratory. The chief stress was laid upon the amount of phosphoric acid soluble in citric acid. The soils which seemed best fitted for the investigation were selected. To prepare them for use they were dried, the lumps broken, and when necessary sifted. They were then put in sacks, marked, and set aside.

Shortly before taking the portions of soils for the experiment the moisture is determined in each. The cylinders are of a size to hold soil containing 13 pounds of dry matter. Before filling, those to be used for a series are made of equal weight by placing gravel in the bottom. The object of this is to facilitate the watering, as explained below. Exceptional quantities of gravel are employed with exceptionally light or heavy soils in order that the soil may come up to the proper level in the cylinder. In filling the cylinders the soil is weighed, the weighed portions of the fertilizers to be added are mixed with it, and the mixture is filled into the cylinder with a wide funnel. After the soil has been properly packed the seeds are put in, twenty kernels in each pot in case of cereals. At first such quantities of water are added as judgment indicates; later the qantity is regulated by the weight so as to maintain the moisture within the range best adapted to the demands of the particular plant.

Photographs of typical groups of experiments are made from time to time during the period of growth.

The plants are harvested when ripe, the straw and grain of cereals being weighed air dry. The straw is prepared for analysis by grinding in the Excelsior mill. The kernels are coarsely ground for water determination, but used whole for determining phosphoric acid and nitrogen. With careful selection of samples the determinations in the unground grain are satisfactory.

The real import of the vegetation experiments, for which these extensive arrangements are provided, will be better understood from consideration of the experience which has led to them.

The proper use of fertilizers has been for many years among the most important branches of inquiry pursued by the Halle station. This is naturally the case because of the intensive farming in the region, the need of the greatest economy in the use of fertilizers and the intimate relation between the farmers and the station. To learn the ways in which the plant acquires the elements of its food and their several functions in its nutrition is essential. But researches for the discovery of these abstract principles were being carried on by such men as Hellriegel in Bernburg, Nobbe in Tharand, and scores of other able investigators in the experiment station and university laboratories near Halle and elsewhere in Germany, not to mention those in other countries. The first especial duty of the Halle station was to find how the farmers in whose special service it works might manure their lands and feed their crops most profitably.

For this purpose the station, under the leadership of Prof. Maercker, instituted years ago a series of field trials with fertilizers by farmers on their own farms, as above related. These were continued year after year on a large scale. The results were collated and published and brought information of great practical value. But as the time passed by and the farmers had learned the more important teachings of the experiments and how to apply them to practice, the need of more fundamental research was more and more pressingly felt. What kinds of soil demand phosphoric acid or potash or nitrogen? In what farms may the latter be best applied? Can not ways be found for determining directly the needs of different soils? It was evident that these questions must be investigated and that ordinary field experiments would not suffice for their solution.

Meanwhile, Wagner's system of experimenting with natural soils in pots and boxes had been successfully developed and seemed to offer the needed means for the study of some of the underlying principles of manuring. Accordingly, a considerable sum was invested by the station in the buildings and apparatus for experiments. A single and very narrow question was selected from the large number, the solution of which was most pressingly called for, and arrangements were made for carrying out many hundreds of individual trials each year for a long series of years. This was done with the full knowledge that several seasons might pass without any practical results, but with the hope

that something definite might in the end be discovered. All this was with the full approval of the practical men in whose hands rests the responsibility for the management of the station. Such are the ways which long experience shows to be best for meeting the needs of practical farming.

BOTANICAL INVESTIGATIONS.

Another branch of the work of the station, which has grown with the demand until it is now quite large, is carried on in the botanical laboratory. The chief duties of the station botanists are the testing of seeds and of feeding stuffs, but they are likewise called upon to make microscopic examinations of fertilizers for the detection of adulterations, and of drinking water and that used for technical purposes. They also inquire into the nature of the diseases of plants and give advice as to the means of prevention or cure. Injuries to vegetation by factories are also subjects of inquiry from time to time. The study of soils with reference to beet nematodes has been given over to a station established in connection with the agricultural institute of the University for the especial investigation of this subject.

The methods of examination of seeds are essentially as agreed upon in 1891 by the German stations which exercise the seed control.* The principal tests made in seeds are those of vitality, water content, and origin or trueness to name.

For germination of most seeds, except those of grasses, plates covered with sand are prepared. These are conveniently covered with glass plates and piled one upon another; by this means space is economized and too rapid evaporation of water avoided. Before placing on the plates the seeds are soaked in distilled water for a number of hours. To maintain a large number of plates at the proper temperature (20° C.) a germinating case (*Keimschrank*) has been devised by Prof. Maercker. It consists essentially of a water chest below, which is warmed by a gas flame, and a cabinet above with shelves and compartments to hold the seeds. The draft from the flame is carried by a flue passing upward through the cabinet.

The duration of the germination test differs, of course, for different kinds of seeds, being ten days for cereals, fourteen days for beet seed, and twenty-eight days for most grasses. On the seventh day of germination, beet seed is sorted; the sprouts are removed from those which have sprouted, after counting the number of sprouts, and the seeds are placed on another plate as before. At the end of fourteen days the test is closed, the sprouted seeds are counted, and the purity determined. Seeds which have been injured in threshing so as to impair their vitality are counted as impurity.

*Verhandlungen der Vorstände von Samenkontrolstationen zu Halle, 1891; Landw. Vers. Stat., 40, p. 69.

The water content is found by drying a quantity of the seed in a bath at 105–110° C. Beet seed, according to the Magdeburg standard, should contain from 12 to 15 per cent of moisture, and not over 3 per cent of impurity.

Often the only available basis for judgment as to trueness to name, or origin, is the weed seeds occurring as impurity, or a field trial.

In the examination of clover seed, lucern, etc., for *Cuscuta* seed, the whole sample is screened in a cylindrical metal sieve, run by a motor.

An idea of the activity of the seed control may be gathered from the number of samples of seeds examined annually. This increased from 449 in 1886 to 735 in 1891, and to 821 during the first four months of 1892.

In the German stations which exercise the so-called control of feeding stuffs by examination of the composition and character of sample, increasing stress is laid upon microscopic tests. These are made in large measure by the botanists of the Halle station. Samples of feeding stuffs not already in a fine mechanical condition are ground in the Dreefs mill, a portion of the original unground sample being retained. A general examination is made as to odor, color, general appearance, etc., and a sample is screened on a set of four sieves with meshes ranging from 0.5 to 1.5 mm.* The portions remaining on each sieve are poured out upon glazed paper and examined with a small lens. Samples are also prepared for the microscope by maceration, slides being made from the finer material with iodine-potassium-iodide solution.

Besides determining its purity an attempt is also made to ascertain the healthfulness of the feeding stuff, and this is often the most difficult part, especially for the novice. Bacteriological examinations are usually omitted as they require too much time.

*These sieves are made by Dreefs, Halle.

ABSTRACTS OF PUBLICATIONS OF THE AGRICULTURAL EXPERIMENT STATIONS IN THE UNITED STATES.

CHEMISTRY.

E. W. ALLEN, *Editor.*

Analytical methods (*New Jersey Stas. Report for 1892, pp. 184–196*).—"In connection with the regular analytical work the station has studied and tested several new or modified methods, as follows: (1) The Gunning method for the determination of total nitrogen, and a modification applicable in the presence of nitrates; (2) the Ulsch method for the determination of nitrates, and a modification applicable in the presence of other forms of nitrogen; and (3) the omission of sodium chloride in the Lindo-Gladding method for the determination of potash."

The Gunning method for the determination of total nitrogen, and a modification applicable in the presence of nitrates (pp. 185–188).—The Gunning method for nitrogen has been compared during the year with the Kjeldahl method. "The results secured were very satisfactory, and the method much preferred to the Kjeldahl, mainly because it obviates the use of potassium sulphide, which is a disagreeable reagent to handle besides adding weight to the solution."

In comparisons on 108 samples, the greatest difference between the two methods was 0.12 and the average difference 0.047 per cent. The Gunning method gave higher results in 59 cases, lower in 41 cases, and in 8 cases the results of the two methods were identical. The results of these comparisons are tabulated.

A modification of the Scovell method for fertilizers containing nitrates is proposed, 10 grams of sulphate of potash being used in place of the metallic mercury in the digestion.

The use of this method was begun early in the season, and the results compare so favorably with those obtained by the official method that it was used as a check in all samples containing nitrates. The only precaution necessary to be observed is to digest at a low temperature at the beginning and then to continue the strong digestion for at least two hours. The advantage of this method over others that have been suggested is mainly due to the fact that all the necessary reagents may be added at once and in the beginning of the determination.

This modification was tested in comparison with the official method on 55 samples in which the nitrate nitrogen ranged from 0.10 to 5.52 per cent, and the results are tabulated. The average difference was 0.01 per cent, and the greatest difference 0.12 per cent.

The Ulsch method for the determination of nitrates, and a modification applicable in the presence of other forms of nitrogen (pp. 188–193).—As the result of a study of the Ulsch method in comparison with others the following modification is recommended:

Weigh off 1 gram of sample in a flat-bottomed 500 c. c. flask. Add 2 grams of reduced iron, 25 c. c. of water and 5 c. c. of sulphuric acid (specific gravity 1.35). Shake well, close the neck of the flask with a rubber stopper in which has been inserted a dropping-bulb. Boil for five minutes; rinse the contents of the bulb into the flask, add about 100 c. c. of water, a little paraffin, and 3 grams of heavy oxide of magnesia. Distill for thirty-five minutes and proceed as usual. The nitrogen obtained represents the nitrates and the ammonia contained in the sample, from which result the amount of nitric nitrogen can be obtained by deducting the percentage of ammonia found.

The chief advantage derived from the use of this method is its rapidity, it being possible for one worker to make twenty-four determinations in from three to four hours, which is twice as rapidly as can be done by the Schulze-Tiemann method, now generally used. With this gain in time, accuracy is not impaired.

The modified Ulsch method was found as accurate as the Schulze-Tiemann method. The results of comparisons are tabulated. The average difference between the two methods on 77 samples was only 0.004 per cent. The Ulsch method for pure salts is given.

The omission of sodium chloride in the Lindo-Gladding method for the determination of potash (pp. 194–196).—Comparative determinations were made of the potash in 191 samples of fertilizers by the Lindo-Gladding method with and without the addition of sodium chloride. The results are tabulated.

The greatest difference in any case is 0.20 per cent, and the average difference 0.076 per cent. In 165 samples the difference is 0.15 per cent or less, and in 130, 0.10 per cent or less. In 94 cases lower results were secured from the omission of salt, in 89 cases higher, and in 8 cases the percentages were identical. Inasmuch as these determinations were made upon different solutions of different amounts of material, and in the usual rapid way during the rush of fertilizer work, these results are considered entirely satisfactory, and the use of sodium chloride in potash work will therefore be abandoned at this station.

Apparatus (*New Jersey Stas. Report for 1892, pp. 197–204, figs. 4*).—Descriptions are given of apparatus for drying in hydrogen, apparatus for fat extraction, a bath for the digestion of phosphates in ammonium citrate, pipettes of special volume for the simplification of calculations, and the use of compressed air for transferring wash solutions.

Apparatus for drying in hydrogen (pp. 197–200).—This is illustrated by two figures. It may be described as a cylindrical copper vessel set into a copper water bath, with constant water supply. The inner vessel is closed at the top by a heavy brass lid which screws down upon a

rubber gasket, and has two openings for hydrogen, one at the bottom and the other at the top. The substances are placed in fat-extraction tubes, and these are placed inside the inner vessel and held upright in a rack. The rack holds eighteen tubes. The hydrogen is supplied from a Kipp generator of ordinary size, a pair of large bottles filled with water being so connected with the generator as to keep the supply of gas regular and constant.

Apparatus for fat extraction (pp. 200–201).—A battery of twelve extractors is figured, with condensers made of 1¼-inch iron tubing, which are connected with each other and all cooled by one stream of water. Water baths for the fat flasks are held in a metal frame below. The apparatus is very compact.

Bath for the digestion of phosphates in ammonium citrate (pp. 201, 202).—This consists of a copper bath 18 by 12 inches and 5 inches deep, within which fits a framework of wood. This frame has openings for the necks of twelve flasks, and when wet its weight is sufficient to immerse the flasks up to the neck. The holes are large enough to permit the flasks to be agitated. "The covering of the entire surface of the water with a nonconducting material maintains the required temperature for half an hour almost without assistance."

Pipettes of special volume for the simplification of calculations (pp. 202–203).—The capacity of pipettes for use in determinations of total, soluble, and insoluble phosphoric acid, of potash, and of chlorine, and the details of the method of procedure are given in a table.

The use of compressed air for transferring wash solutions (pp. 203, 204).—The solutions used in washing in various kinds of determinations are contained in large bottles and are forced out for use by means of compressed air, instead of using ordinary wash bottles. The compressed air is secured in the following manner: "A standpipe, 7½ feet high, is kept full to overflowing by a connection with the city water and tends to empty into a large bottle, which at the start is full of air. The latter is consequently under pressure, and is conducted by ¼-inch lead tubes to various parts of the laboratory, where any wash bottle of any size may be connected."

ZOÖLOGY.

Carbon bisulphide as a squirrel exterminator, C. P. Fox (*Idaho Sta. Bul. No. 4, July, 1893, pp 6–10*).—A popular bulletin on the subject of ground squirrels or gophers, two species of which, *Spermophilus elegans* and *S. columbianus*, are mentioned as abundant in different parts of the State. Various methods are suggested for their destruction, carbon bisulphide being especially recommended. Detailed instructions are given for the use of this exterminator, and its more general use advised.

A patent explosive bomb is described, which, being placed in the burrows and exploded, liberates a poisonous gas. It is said to be very effective, but too expensive for general use.

FERTILIZERS.

W. H. Beal, *Editor.*

The production of manure, G. C. Watson (*New York Cornell Sta. Bul. No. 56, Aug., 1893, pp. 157–175*).—During the winters of 1891–'92 and 1892–'93 experiments were made to determine the amounts of nitrogen, phosphoric acid, and potash recovered in the excrement of sheep, calves, pigs, cows, and horses, as affected by the age of the animals and the quantity and quality of the food. Similar experiments were reported in Bulletin No. 27 of the station (E. S. R., vol. III, p. 89).

Experiments with sheep (pp. 159–163).—Ten mature thoroughbred Shropshire and Horn Dorset rams and two grade Merino ewes, in lots of two each, were kept in pens on water-tight galvanized iron pans, and fed liberally on hay, corn, and oats, or hay, wheat bran, cotton-seed meal, and linseed meal, for periods of from twelve to twenty-one days. The amount and composition of the food was determined, and the animals were supplied with sufficient finely cut wheat straw of known composition to keep them clean. The amount and fertilizing constituents of food consumed, and the fertilizing value of the excrement voided and of the manure obtained are tabulated.

The voidings recovered in these experiments were comparatively rich in nitrogen and poor in phosphoric acid and potash. This is true not only of the average, but also of each individual experiment. * * * Where the aim was to feed as nearly as possible a maintenance ration, the proportion of nitrogen to phosphoric acid and potash did not differ materially from the proportion of these ingredients recovered in experiments where the sheep were fed all the grain they would eat. * * *

The average value of the excrement recovered, per 1,000 pounds of live weight of animal per day, which is a little over 7 cents, fairly represents the value of the excrement from a large flock of sheep where a portion of them are fattening animals. It is true that during some of the experiments the sheep were fed a heavy grain ration, but in others they were fed a light ration of carbonaceous grain. The average ought to represent fairly well the excrement from flocks fed clover hay and a fair grain ration.

The relation of the amount of water drank to the amounts of dry matter and of nitrogen is shown in a table.

These experiments show quite conclusively that the water consumption is governed far more by the amount of nitrogen in the food than by the total amount of dry matter which it contains. * * * With one exception the lowest in nitrogen consumption drank the least water, the next higher in nitrogen consumption was the next higher in water drank, the third in nitrogen consumption also was third in the amount of water drank, and this order was maintained throughout the remaining experiments. * * *

It does not follow that where nitrogenous food forms a large portion of the ration that the manure will contain a much larger per cent of nitrogen than if the food were only moderately rich in nitrogenous constituents, for in ordinary practice the increased secretion of urine will demand a greater supply of bedding, which would decrease the percentage of nitrogen in the manure, so that the proportion of nitrogen to the weight of manure would not be increased, while the total nitrogen voided would be in great excess of that voided from less nitrogenous food.

Experiments with calves (pp. 163, 164).—Two high grade Holstein calves were placed on the manure pans as described in the experiments with sheep, and bedded liberally with finely cut, clean wheat straw. The food consisted in one case of skim milk, corn meal, wheat bran, and hay, and in the other of corn meal, linseed meal, wheat bran, and hay; and the experiments lasted twelve and fifteen days, respectively. Data similar to that for the experiments with sheep are tabulated.

As would be expected, the manure made in the experiment where skim milk formed a considerable portion of the diet was particularly poor in nitrogen and phosphoric acid. Not only was the skim milk more digestible, which resulted undoubtedly from a greater proportion of these fertilizing constituents being used to build up the animal body than was the case in the experiment where less digestible food was fed, but the increased secretion of urine from the skimmilk diet required so great an amount of bedding to keep the calves clean that the manure was necessarily poor. * * *

The excrement recovered in these two trials with calves will not differ materially in quantity or quality from that recovered in ordinary practice, for the food fed did not differ materially from that usually fed throughout the country. So that the average value recovered per 1,000 pounds of live weight of animal per day, which is nearly 7 cents, will represent the value of the excrement produced from this class of animals throughout the State as well as on the university farm.

Experiments with pigs (pp. 164–166).—Three seven-day experiments, each with three thrifty Poland-China pigs, were carried out as with the sheep. Two lots were fed skim milk, corn meal, and meat scraps, and one skim milk, corn meal, wheat bran, and linseed meal.

The value of the excrement per ton is nearly the same in each of these three experiments, while the value recovered per day is nearly twice as much when the ration consisted of corn meal and meat scraps, as when corn meal, wheat bran, and linseed meal were fed. The highly nitrogenous ration greatly increased the liquid voidings and this, more than any other one thing, caused the great weight of total voiding per day without proportionately increasing the percentage of nitrogen. * * *

These pigs were fed a highly nitrogenous ration for the production of lean meat and without doubt the excrement, valued at 17 cents per day from 1,000 pounds live weight of animal, is considerably more than would have been obtained had the grain ration consisted mostly of corn.

Experiments with cows (pp. 166–169).

Eighteen cows of the university herd were kept tied in the stalls for twenty-four hours and bedded liberally with cut wheat straw and the drops in the rear of the cows sprinkled with plaster. The ration fed consisted of hay, corn, silage, grain, and roots. * * *

The ration fed during these experiments was the same as that usually fed; no change of food was made in any way on account of the manure experiments. * * * The fertilizer value of the excrement recovered during these trials will fairly represent

the average value recovered from the university herd during the winter months when the cows are fed a hay and grain ration similar to that given. * * *

The value per day of excrement from 1,000 pounds live weight of animals, which is a trifle over 8 cents, represents the value of the excrement produced by the university herd at the prices given. This agrees closely with the results of a former trial. * * *

As the amount of bedding used in these experiments did not differ materially from the amount used in ordinary practice where the cows are kept tied in the stalls most of the time, the average of these analyses may be said to fairly represent the manure made by milch cows when fed a liberal grain ration.

Experiments with horses (pp. 169, 170).

Five horses, 4 work horses, and 1 two-year-old colt, were put on an experiment for manure production for twenty-four hours. These horses were kept in stalls, the floors of which were water tight. Both the stalls and the drop at the rear of the stalls were bedded with finely cut wheat straw and sprinkled with plaster.

The work horses were fed hay and a grain ration of 12 quarts per day, consisting of oats, corn meal, and wheat bran; the colt had hay only. * * *

In this experiment the quantity of straw used as bedding was sufficient to keep the horses clean, and probably would be similar in quantity to the amount of straw used in ordinary practice. The amount of plaster used, however, was greater than would ordinarily be used. This would tend to make the manure of less value per ton than average horse manure where plaster was not used.

Discussion and summary of results (pp. 170–175).—The following table gives a summary of the principal results obtained in the above experiments:

Amount, composition, and value of manure produced by different kinds of farm animals.

	Analyses and value per ton of manure.					Amount and value of manure per 1,000 pounds live weight per day.		
	Water.	Nitrogen.	Phosphoric acid.	Potash.	Value per ton.*	Pounds per day.	Value per day.*	Value per year.*
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*				
Sheep	59.52	0.768	0.391	0.591	$3.30	34.1	$0.072	$26.09
Calves	77.73	0.497	0.172	0.532	2.18	67.8	0.067	24.45
Pigs	74.13	0.840	0.390	0.320	3.29	83.6	0.167	60.88
Cows	75.25	0.426	0.290	0.440	2.02	74.1	0.080	29.27
Horses	48.69	0.490	0.260	0.480	2.21	48.8	0.076	27.74

* Valuing nitrogen at 15 cents, phosphoric acid at 6 cents, and potash at 4½ cents per pound.

It will be noticed that the average amount of nitrogen recovered in all the manures is considerably more than that of potash and about twice the amount of phosphoric acid. It is true that in some cases the food fed was highly nitrogenous, but in the majority of cases the ration was the same as that usually fed on the university farm. * * *

The largest amounts recovered per day were in experiments where the food consumed gave a comparatively narrow nutritive ratio, or else the food was largely liquid, as was the case with the calves. In either case it was the amount of urine secreted that greatly increased the total weight of excrement.

The average percentages of the fertilizing elements of the food recovered in the manure are shown in the following table:

Fertilizing elements of the food recovered in the manure.

	Number of experiments.	Nitrogen.	Phosphoric acid.	Potash.
		Per cent.	*Per cent.*	*Per cent.*
Sheep	6	62	73	64
Calves	2	56	39	96
Pigs	3	80	73	89
Average		70	62	83

Average of the three constituents, 71 per cent.

Without doubt the general average of the plant food recovered is considerably lower than would be the case in ordinary practice where a larger proportion of mature animals are kept. It is frequently stated in general terms that 80 per cent of the fertilizer value of animal food is recovered in the excrement, and when we consider that of the eleven experiments five were made with young animals, it is fair to presume, from the results of these experiments, that considerably more than 70 per cent would be recovered in ordinary practice, particularly if a considerable portion of the stock fed were fattening animals.

In order to facilitate the application of the results of these experiments in general practice, the fertilizing constituents and value of a number of common feeding stuffs are given and discussed.

Fertilizer inspection and analyses in New Jersey, E. B. VOORHEES, L. A. VOORHEES, J. P. STREET, and I. A. LEE (*New Jersey Stas. Report for 1892, pp. 9–84*).—This report includes discussions, accompanied by analytical and statistical data, of the following topics: The quantity and value of the fertilizers used in the State during the year 1892; comparison of the year's trade with that of preceding years (1882–1891); the market prices of fertilizers; incomplete fertilizers—their economic purchase and rational use; home mixtures—formulas, composition, and cost; and complete fertilizers, bones, and miscellaneous products—their guaranteed chemical composition and relative commercial value. The principal part of this matter has already appeared in Bulletins Nos. 88 and 89 of the station (E. S. R., vol. IV, pp. 245 and 465).

The total sales of fertilizers reported this year [47,654 tons, valued at $1,509,921] are greater than for any preceding year since 1882. The complete fertilizers, 33,821 tons, indicate an expenditure this year of about $1,150,000, or 76 per cent of the total. This percentage is almost identical with that shown in previous years. In raw materials an increase is noticed in all cases except boneblack superphosphate and muriate of potash. The amount of ground bone reported as sold during the last year is considerably less than that reported in 1891. * * *

In raw materials there was a slight decrease in price in all cases except kainit and muriate of potash. Ground bone is a trifle lower, while the price of ammoniated superphosphates without potash is slightly higher. These fluctuations in price, however, have had little effect on the price of complete fertilizers; the average price this year, $34.19 per ton, is almost identical with that of last year, and is lower than in any year since the station's establishment.

Miscellaneous analyses (*New Jersey Stas. Report for 1892, p. 156*).—Tabulated analyses with reference to fertilizing ingredients of tomato vines, Niagara grapes, grapevine prunings, mixed sedge and rush, potato parings, and the roots and stubble of crimson clover (see below).

Fertilizer inspection and analyses in West Virginia, J. A. MYERS (*West Virginia Sta. Special Bul., Aug. 10, 1893, p. 1*).—Analyses of 126 samples of commercial fertilizers collected during 1893 are tabulated.

FIELD CROPS.

J. F. DUGGAR, *Editor.*

Crop tests, E. B. VORHEES (*New Jersey Stas. Report for 1892, pp. 130–148*).

Synopsis.—The following subjects are treated: Experience of New Jersey farmers with crimson clover; composition of crimson clover; methods of growing tobacco; and notes on sugar beets grown in the State.

Crimson clover (pp. 130–144).—The experience of 21 farmers with this plant was uniformly favorable. The plant proved hardy and vigorous under relatively unfavorable weather conditions. Several growers emphasized the importance of home-grown seed. The following table gives the composition of green clover cut May 28 when in full bloom, and of two samples of hay:

Composition of crimson clover.

	Water.	Crude fat.	Crude fiber.	Crude protein.	Crude ash.	Carbohydrates.	Albuminoid nitrogen.	Total nitrogen.	Phosphoric acid.	Potash.	Lime.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Green crimson clover	78.42	0.57	5.89	3.48	1.99	9.65	0.44	0.56	0.11	0.45	0.13
Crimson clover hay	7.22	1.49	34.90	15.06	9.32	32.01	2.18	2.41	0.71	2.78	1.77
Do	8.82	1.90	29.15	16.04	7.41	36.68	1.82	2.57	0.60	1.68	1.83

The above analysis of green crimson clover is compared with average analyses of red clover and of green rye, calculated to the same water content. Green crimson clover contains 17 per cent more protein than red clover and 59 per cent more protein than green rye. It contains nearly double the amount of carbohydrates found in rye and only about half as much crude fiber. Comparing the average composition of three samples of crimson clover hay with the average composition of red clover, as established by the station in 18 6, and calculating both to the same water content, crimson clover hay contains more crude protein and

less carbohydrates than red clover hay. The amount of digestible matter in 100 pounds of crimson clover hay was 0.95 pound of fat, 14.52 pounds fiber, 9.25 pounds of protein, and 26.28 pounds of carbohydrates; and in 100 pounds of red clover 1 pound of fat, 13.25 pounds of fiber, 6.48 pounds of protein, and 26.9 pounds of carbohydrates. The nutritive ratio of crimson clover was 1:4.7, and of red clover 1:6.5. On this basis a ton of crimson clover hay contained 55.4 pounds of digestible protein in excess of that found in a ton of red clover hay.

To ascertain the value of crimson clover as a green manure the roots and stubble together and the tops were analyzed, with the following result:

Analyses of tops and roots and stubble of crimson clover.

	Total dry matter.	Ash.	Organic matter.	Nitrogen.	Phosphoric acid.	Potash.	Lime.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Tops	21.58	1.99	19.59	0.56	0.11	0.45	0.43
Roots and stubble	25.00	2.85	22.15	0.33	0.08	0.47	0.34

Of the whole plant, including roots to a depth of 6 inches, 15 per cent consisted of roots and stubble, so that for every ton of green clover cut there was left 353 pounds of roots and stubble.

A crop of 5 tons of green clover per acre plowed under would furnish 2,350 pounds of organic vegetable matter, or as much as that supplied by 7.5 tons of average stable manure. This vegetable matter would supply nearly as much nitrogen and potash as would be furnished by the amount of manure mentioned, but considerably less phosphoric acid.

Tobacco (pp. 144–146).—An account is given by a successful tobacco grower in the State of the methods of growing and handling the tobacco crop. This grower manures heavily with barnyard manure and with commercial fertilizers, and estimates the expenses of manuring and cultivation at $125 per acre.

Sugar beets (pp. 147, 148).—Notes on a crop grown in Camden County, with analyses of the same. The stand was poor and the yield light. A sample of beets analyzed showed 13.23 per cent of sugar with a purity coefficient of 85.5 per cent for the juice.

Experiments with fertilizers on white potatoes, E. B. VOORHEES (*New Jersey Stas. Report for 1892, pp. 100–104*).—These experiments were conducted on a plan similar to that followed in 1891 (Special Bulletin P; E. S. R., vol. III, p. 881), the object being "to test the effect of different methods of manuring and of the effect upon the yield and quality of the potato of the different forms of potash salts. It differed from the plan last year in that the kainit was not used, since in the experiments of 1890 and 1891 it was distinctly shown that the direct application of large quantities of this salt was not beneficial."

Data relating to yield and composition of the product from the dif-

ferently manured plats are tabulated, but on account, it is believed, of the dry weather at time of setting, "there is such a lack of uniformity of yields even on plats treated alike that except perhaps in the case of [one] experiment nothing positive is shown in reference to the effect of different forms of potash salts. The only point shown is that, on the whole, barnyard manure alone or in connection with chemical manures proved more useful under the conditions than the chemical manures alone."

HORTICULTURE.

Experiments with fertilizers on tomatoes, E. B. VOORHEES (*New Jersey Stas. Report for 1892, pp. 85–100*).—This is a continuation on a farm in Gloucester County, New Jersey, of experiments begun in 1889 and reported in Special Bulletin O of the station (E. S. R., vol. III, p. 879). These experiments were planned primarily to determine the value of nitrate of soda as a fertilizer for tomatoes. This material was used on twentieth-acre plats at the rate of 160 and 320 pounds per acre. It was applied alone in one (May 6) and two applications (May 6 and June 7), and in combination with muriate of potash (160 pounds) and dissolved boneblack (320 pounds). Barnyard manure at the rate of 20 tons per acre was applied on one plat, and two remained unfertilized. The practice of the most successful growers was followed in the management of the crops. Data relating to yield and selling price of tomatoes at different pickings, the relation of the yield and value of early tomatoes to the total yield and total value of the crop, and the amount and value per acre of the increased yield due to the different fertilizers and to different methods of applying nitrate of soda, are tabulated and discussed. The results in general confirm those of previous experiments.

The [average] results of four experiments show that as a fertilizer for tomatoes (1) nitrate of soda is superior to both barnyard manure and mineral fertilizers alone; (2) nitrate of soda alone is on the whole but slightly less effective than the complete manure; (3) when small quantities of nitrate are used, the second application is advantageous; and (4) large quantities (320 pounds per acre) of nitrate are more effective than small quantities (160 pounds per acre); * * * and permit of the following practical suggestions in reference to fertilizing: (1) Where land has been heavily fertilized or manured for the previous crop, apply evenly over the row from 200 to 300 pounds of nitrate of soda per acre, one half at time of setting the plants and the remainder from three to four weeks later; (2) where the land is light and has not been heavily manured, apply broadcast and harrow into the soil before setting the plants 500 pounds per acre of a mixture made up of two parts of boneblack superphosphate and one part of muriate of potash, and from 150 to 250 pounds of nitrate of soda in the same manner as suggested above.

Experiments with fertilizers on sweet potatoes, E. B. VOORHEES (*New Jersey Stas. Report for 1892, pp. 104–122*).—Two experiments

on the same plan as those reported in Special Bulletin P of the station (E. S. R., vol. III, p. 883) were carried out on 14 twentieth-acre plats in 1892, on two farms in the State, the soil of one being "a sandy loam in good state of fertility and well adapted to sweet potatoes," and of the other, a poor light sand with a slight admixture of gravel. The objects of these experiments were "(1) to learn whether profitable crops could be raised with chemical manures alone, (2) to study the comparative effect of nitrogen in the form of nitrate of soda or dried blood, and (3) to study the comparative effects of different quantities of New York horse manure alone and in combination with chemical manures."

The fertilizers applied per acre were as follows: A mixture of 320 pounds of dissolved boneblack and 100 pounds of muriate of potash was used alone and in combination with 200 pounds of nitrate of soda and with 280 pounds of dried blood, respectively; a mixture of 480 pounds of dissolved boneblack and 240 pounds of muriate of potash was used in combination with 300 pounds of nitrate of soda, and with 420 pounds of dried blood, respectively; and mixtures of 160 pounds of dried blood, 80 pounds of muriate of potash, and 100 pounds of nitrate of soda, and double these amounts, were used with 5 and 10 tons of barnyard manure, respectively. Barnyard manure was also used alone in amounts of 10 and 20 tons.

Tables give the amount and value of the large and small potatoes in each case and the food and fertilizing constituents of the product from the differently fertilized plats. The results secured in the experiment on the first farm permit of the following statements regarding the manuring of sweet potatoes:

(1) Profitable crops can be raised with chemical manures alone and the net profits of the crop are greater than from New York horse manure alone.

(2) Organic forms of nitrogen, as dried blood, are more useful than nitrate of soda.

(3) Combinations of chemical and horse manures are more satisfactory than horse manure alone.

In the experiment on the second farm "the plants were set late and owing to the very dry weather did not make a rapid growth."

No merchantable potatoes were secured on the unfertilized plats. The average yield of all the fertilized plats was 53.2 bushels per acre; the yield from the plats treated with barnyard manure alone was 55.8 bushels, and from a combination of yard and chemical manures, 44.8 bushels. Chemical manures were, therefore, but little less effective than the yard manure alone, even under the adverse conditions of this experiment, and were much more effective than yard and chemical manures in combination.

Raspberries and blackberries, F. W. CARD (*New York Cornell Sta. Bul. No. 57, Sept., 1893, pp. 179–204*).—A popular bulletin on raspberries and blackberries. In treating of black raspberries the following topics are discussed: Varieties; soil and fertilizers suited to this crop; preparation and planting; pruning; harvesting; drying out of doors, under glass, and with evaporators; yield; and profit.

Under red raspberries and blackberries the following points are noted: Yield, evaporating and drying the fruit, thinning the fruit, pinching back the canes, hardiness of immature canes, forcing, and diseases. Removing young red raspberry canes from old plantations, autumn fruiting, and effect of spraying on pollination are also discussed. The following is the author's recapitulation:

(1) Black raspberries can be made a profitable farm crop when grown for evaporating purposes, and gathered by the aid of the berry harvester, regardless of proximity to markets. An average yield with good culture is about 75 to 80 bushels per acre.

(2) An average yield of red raspberries is about 70 bushels per acre. An average yield of blackberries is about 100 bushels per acre.

(3) A majority of growers find low summer pinching of blackberries best for most varieties.

(4) Growers are about equally divided in opinion as to whether red raspberries should be pinched back at all in summer. If pinched, it should be done low and early. The canes should be made to branch low.

(5) Evaporating red raspberries has not yet proved profitable.

(6) There seems to be no immediate prospect that blackberries can be profitably grown for evaporating purposes.

(7) Berry canes which made their entire growth after July 6 stood the winter as well or better than those which grew during the whole season.

(8) Removing all young canes from a plantation bearing its last crop of fruit materially increases the yield.

(9) Raspberries and blackberries can be successfully grown under glass, but require artificial pollination and a comparatively high temperature.

(10) Under ordinary conditions, thinning the fruit of raspberries and blackberries, other than that done by the spring pruning, does not pay.

(11) Cutting off the bearing canes early in spring does not induce autumn fruiting of raspberries.

(12) Frequent spraying with water throughout the blossoming period did not interfere with pollination and subsequent fruit production.

(13) The only remedy for red rust is to dig up and burn at once every plant found to be affected. Cut away and burn all canes affected with anthracnose pits and spray the plantation with Bordeaux mixture. Root galls weaken the plants, causing them to appear as if suffering from poor soil. Removing the plants and burning the roots is the only remedy.

(14) The dewberry of the Pacific slope is *Rubus vitifolius*. This species often bears imperfect or pistillate flowers. The Skagit Chief bore pistillate flowers with us and was therefore infertile with itself.

Strawberries, W. B. ALWOOD (*Virginia Sta. Bul. No. 27, Apr., 1893, pp. 63–70*).—Directions for planting, mulching, and cultivating strawberries are given and notes and tabulated data on 16 varieties. Spring planting is preferred to autumn planting. Summer planting has not succeeded at the station. Mulching, which is highly recommended, is not believed to make the crop late if intelligently managed. The mulch from over the row is removed April 8 to 15 and blooms appear about May 1, but the mulch is again turned over the rows at night if a damaging frost is threatened.

The test plantation includes 120 varieties. Of those reported upon in Bulletin No. 7 of the station (E. S. R., vol. II, p. 255) only those of

special importance are referred to in the present bulletin, which is especially concerned with new varieties. Tabulated data and notes on 16 varieties give for each the date when first bloom appeared, date of first ripe fruit, date of picking, relative productiveness (on a scale of 10), and quality (on a scale of 10).

"Michel Early is decidedly the choice for strictly early crop. Haverland and Beder Wood follow it closely, and a number of others come in almost with these.

For a home garden we could not name a better selection than Haverland, Beder Wood, and Parker Earle, all quite hardy and furnishing fruit the whole season. These, with Great Pacific, Shuster Gem, and Warfield, ought to furnish a list from which commercial growers should realize the best results. Of the very late sorts, Gandy and Summit are the best, but are valuable only for amateurs in the home garden."

Experiments with fertilizers on strawberries, E. B. VOORHEES (*New Jersey Stas. Report for 1892, pp. 127–129*).—To plants of Sharpless strawberries, which had been set in the spring of 1891, on sandy loam soil with clayey subsoil and liberally fertilized with a complete manure, a top dressing of 200 pounds of nitrate of soda per acre was applied in the spring of 1892, and the effect on the growth of the plants and the yield and value of the fruit observed.

The effect of the spring application of nitrate was apparent almost immediately; the plants assumed a richer color and showed a stronger and more vigorous growth than those upon which no application was made. The plants blossomed well and the berries set full in all cases. At the time of picking, the fruit on the nitrated plats was larger though no earlier than upon the plats upon which no spring application had been made. * * *

The gain in yield, due to the spring application of nitrate, was 340 quarts per acre or 18 per cent. This increase, while showing the usefulness of this method of using nitrate of soda, was much less profitable than in the experiment of 1891 [Report of the station for 1891; E. S. R., vol. IV, p. 42], where the nitrate was applied to plants which had not been previously fertilized with nitrogen, though well supplied with the mineral elements.

The orange and other citrus fruits, W. C. STUBBS (*Louisiana Stas. Special Bulletin, pp. 1–50, figs. 9*).—A compilation embracing notes on the culture of citrus fruits in Louisiana, protection of the orange against frost, botany of the orange, methods of propagation, best stocks for the orange, planting and growing orange trees, composition of oranges and lemons, fertilizers for the orange, and list of varieties of the orange, lemon, shaddock, pomelo or grape fruit, citron, cumquat (*Citrus japonica*), and *Citrus medica trifoliata*. Views and cultural methods of orange-growers in Louisiana and Florida are given at length.

As a stock the sweet, sour, and bitter-sweet types may be used, also the rough lemon or wild lemon of Florida, the grape fruit, *Citrus trifoliata*, and others. *Citrus trifoliata* is especially recommended as a hardy dwarf and as a suitable stock for the Satsuma, the hardiest variety of orange.

From the answers received to a circular sent to orange growers in Florida and Louisiana it appears that soils of several types are suited to the orange, and that thorough preparation and drainage of the land are necessary. The majority advocated shallow planting, sour stock budded in spring, and cultivation when the orchard is not sown to some green crop. Growers budded at all distances from 2 to 12 inches above the ground. It appeared that very few growers had practical experience as to the advantages of wind-breaks.

The station has begun experiments in the care of orange orchards, planting hoed crops, cowpeas, alfalfa, and crimson clover between the rows of trees, and using these crops as hay, plowing them under, or permitting them to rot on the surface. Up to date the trees show no difference from the several methods of cultivation, but the most profitable treatment has been that with alfalfa, since this plant has furnished a large amount of hay.

Field experiments with fertilizers on peach trees, E. B. VOORHEES (*New Jersey Stas. Report for 1892, pp. 122–127*).—This is a report of progress in experiments on two farms in Somerset County, New Jersey, which have been carried on for a number of years (see Annual Report of the station for 1891; E. S. R., vol. IV, p. 39).

The yield and value of crop on plats manured with nitrate of soda, superphosphate, and muriate of potash, singly, two by two, and all three combined; and with plaster, lime, and barnyard manure, are tabulated for each year from 1887 to 1892 for one experiment.

There is a decided gain in all cases except from the use of nitrate of soda alone, which shows a loss of $44 to date. Potash has proved the most valuable of the single elements, the net gains being greater than those from the use of barnyard manure. Superphosphate was also profitable, the use of which together with potash shows the highest net gain from an incomplete fertilizer. Nitrate of soda added to these elements gives the largest net gain, an increase of $75.60, due to the nitrogen. Barnyard manure and lime proved the least profitable of the materials used, except the nitrate [alone]. The cost of the manure renders it a much less profitable manure than other kinds of plant food, though no ill effects have been observed from the large quantities annually applied. The average net gain from the use of complete chemical manures for the six crop years is $60.61, and $36.14 from the use of barnyard manure, a difference of $24.37 in favor of the fertilizer.

For the second experiment the yield and value of the fruit from differently fertilized trees are tabulated for 1890, 1891, and 1892. Corn was grown in the orchard in 1890 and 1891; in 1892 it was seeded to crimson clover. "The effect of fertilizers, while very apparent on the crops of corn, is not particularly noticeable on the trees, the main difference being a deeper color and stronger growth of foliage on the fertilized plats."

SEEDS—WEEDS.

WALTER H. EVANS, *Editor.*

Notes on weeds, B. D. HALSTED (*New Jersey Stas. Report for 1892, pp. 350–381, figs. 9*).

Synopsis.—Notes on the winter condition of some weeds, the root systems of common weeds, a second list of 100 weeds, and lists and descriptions of 100 weed seeds, and of weed seeds in clover seed.

The winter condition of some weeds (pp. 350–355).—Brief notes and illustrations are given of the winter and early spring conditions of the following of our more common weeds: Pasture thistle (*Cnicus odoratus*), narrow-leaved stickseed (*Echinospermum lappula*), mayweed (*Anthemis cotula*), evening primrose (*Œnothera biennis*), bulbous buttercup (*Ranunculus bulbosus*), round-leaved mallow (*Malva rotundifolia*). dandelion (*Taraxacum officinale*), wild parsnip (*Pastinaca sativa*), teasel (*Dipsacus sylvestris*), flea bane (*Erigeron* spp.), oxeye daisy (*Chrysanthemum leucanthemum*), narrow leaved plantain (*Plantago lanceolata*), mullein (*Verbascum thapsus*), yellow rocket (*Barbarea vulgaris*), cinquefoil (*Potentilla canadensis*), bugloss (*Echium vulgare*), curled dock (*Rumex crispus*), sorrel (*R. acetosella*), henbit or dead nettle (*Lamium amplexicaule*), pepper grass (*Lepidium virginicum* and *L. campestre*), moth mullein (*Verbascum blattaria*), catnip (*Nepeta cataria*), wild carrot (*Daucus carota*), pigeon weed or wheat thief (*Lithospermum arvense*), and shepherd's purse (*Capsella bursa-pastoris*).

The root systems of our weeds (pp. 355–364).—Descriptions and illustrations of the root systems of the following common weeds: Wild parsnip (*Pastinaca sativa*), salsify (*Tragopogon porrifolius*), dandelion (*Taraxacum officinale*), burdock (*Arctium lappa*), evening primrose (*Œnothera biennis*), wild carrot (*Daucus carota*), teasel (*Dipsacus sylvestris*), bugloss (*Echium vulgare*), chicory (*Cichorium intybus*), mullein (*Verbascum thapsus*), shepherd's purse (*Capsella bursa-pastoris*), curled dock (*Rumex crispus*), moth mullein (*Verbascum blattaria*), hound's tongue (*Cynoglossum officinale*), round-leaved mallow (*Malva rotundifolia*), man-of-the-earth (*Ipomœa pandurata*), sorrel (*Rumex acetosella*), bouncing bet (*Saponaria officinalis*), and dogbane (*Apocynum androsæmifolium*).

A second century of American weeds (pp. 364–370).—A list of 100 weeds prepared for distribution by the author. The list is supplemental to the previous one mentioned in the Annual Report of the station for 1891 (E. S. R., vol. v, p. 45).

A century of weed seeds (pp. 370–377).—A description and illustrations of a collection of 100 weed seeds prepared for distribution by the author. They are arranged according to the systematic orders and

may be classified as 38 native and 62 foreign species, or as 48 annuals, 35 perennials, 15 biennials, and 2 either annual or biennial.

Weed seeds with clover seed (pp. 377–381).—A list is given of 12 species of weed seeds that are most commonly met with in clover seed, together with their descriptions and illustrations. The seeds mentioned are those of buttercup (*Ranunculus bulbosus*), pepper grass (*Lepidium campestre*), bouncing bet (*Saponaria officinalis*), bladder ketmia (*Hibiscus trionum*), rattle box (*Crotalaria sagittalis*), evening primrose (*Œnothera biennis*), heal all (*Brunella vulgaris*), motherwort (*Leonurus cardiaca*), catnip (*Nepeta cataria*), narrow-leaved plantain (*Plantago lanceolata*), common plantain (*P. major*), and smartweed (*Polygonum pennsylvanicum*).

DISEASES OF PLANTS.

WALTER H. EVANS, *Editor.*

Report of the botanical division of New Jersey Station, B. D. HALSTED (*New Jersey Stas. Report for 1892, pp. 275–386, figs. 35*).

Synopsis.—General review of the year's work, notes on *Peronosporeæ*, garden pink rust, fungus diseases of roses, bacterial disease of beans, damping-off of eggplants, a serious filbert disease, diseases of *Sedum* and *Tropæolum*, developments of the pycnidia of *Phyllosticta*, blights of variegated plants, a mignonette fungus, secondary spores in anthracnoses, fungus diseases of the quince, a study of fruit decays, treatment of fungus diseases, fungi injurious to weed seedlings, common fungi of weeds, winter condition of weeds, root system of weeds, a second century of weeds, a century of American weed seeds, weed seeds with clover seeds, and notes on nematodes.

General review of the year's work (p. 275).—A brief summary of the field and laboratory work on fungus diseases, weeds and weed seeds, and the injuries caused by nematodes, especially the injury to roses.

Notes upon the Peronosporeæ for 1892 (pp. 276–278).—The author gives brief notes on the occurrence and abundance of the following species: *Phytophthora infestans, Sclerospora graminicola, Plasmopara viticola, P. pygmæa, P. halstedii, P. geranii, Brema lactucæ, Peronospora arthuri, P. parasitica, P. potentillæ, P. cubensis, P. effusa, P. alta, Cystopus ipomœæ-panduratæ, C. candidus, C. tragopogonis, C. spinulosus, C. portulacæ,* and *C. amaranthi.*

The garden pink rust (pp. 278–280).—The fungus (*Puccinia arenariæ*) causing the rust of common pinks is figured and described. It has quite a range of host plants and is very different from the one causing carnation rust. The common pink rust is to be found on nearly every member of the pink family. All diseased plants should be removed and burned wherever found.

Fungus diseases of roses (pp. 280–283).—An account is given of the more common and destructive fungus diseases of the rose. Black

spot, due to *Actinonema rosæ*, is one of the most widespread diseases, attacking some varieties more severely than others. When attacked, the foliage quickly develops the characteristic black spots, the leaves elsewhere become pale and fall to the ground nearly defoliating the plants. The dead leaves should be gathered and burned and the disease may be held in check by the use of ammoniacal carbonate of copper as a spray. The powdery mildew (*Sphærotheca pannosa*) is very troublesome both in rose houses and outdoors, giving the leaves a powdery appearance. The fungus may be completely destroyed by fumes of sulphur or by the use of potassium sulphide as a spray. A suggested method for use in the rose house is to close the house about 8 a. m., run the temperature up to about 75°, and then with a bellows fill the house with sulphur. Let the temperature rise to 85° or 90° and then let in the air gradually. Another mildew, *Peronospora sparsa*, is reported. A rust (*Phragmidium subcorticium*) is reported as not unlikely to become troublesome. The canes become blistered, knotted, and distorted, the whole covered with masses of orange-colored spores. Cutting away and burning affected plants seems about the only effectual remedy. An anthracnose, due to *Glœosporium roseæ*, is mentioned as rather destructive. When badly affected the leaves are small and pale and the canes die at the tips. The disease spreads rapidly, but four days being required from the time the spores were introduced into a culture until mature spores were formed. No remedy is given.

A bacterial disease of beans (pp. 283–285).—A widespread disease of bacterial origin is reported upon. It seems to be common to all kinds of beans, and the author's experiments would indicate that the disease is propagated with the seed. When of a marketable size the pods show brown, irregular, somewhat sunken pits, which may be distinguished from those of the pod spot, as the latter causes deep pits which are pinkish and spore-bearing. Care must be exercised in securing seed that is not infected.

Damping-off or falling of eggplants (pp. 286, 287).—Brief notes on the fungus (*Pythium debaryanum*) causing this disease. Tests of fungicides are in progress, and corrosive sublimate seems promising as a means for its repression.

A filbert disease (pp. 287–289).—A description and detailed report of this disease are given. It has been previously described in the Annual Report of the Massachusetts State Station for 1892 (E. S. R., vol. v, p. 193).

A disease of ornamental sedums (pp. 289, 290).—The author gives brief notes on an anthracnose of sedum due probably to an undescribed species of *Colletotrichum*.

Pleospora of Tropæolum majus (pp. 290–293).—An account is given of the cultivation of a *Pleospora*, probably new, of the *Alternaria* type, in cultures from the leaves of *Tropæolum*. Should it prove new, the author suggests the name *Pleospora tropæoli* for it.

Development of the pycnidia of a Phyllosticta (pp. 293, 294).—An account of the formation of pycnidia of *Phyllosticta funkia* on artificial cultures, and description of the same.

Blights of variegated plants (pp. 294–301).—Descriptions and illustrations of blights of the following variegated plants: Plantain lily, *Funkia undulata variegata*, *Aspidistra lurida variegata*, *Pelargonium* spp., *Alternanthera* sp., and *Anthurium* spp. The use of copper compounds, especially ammoniacal carbonate of copper, is recommended as preventive treatment.

A mignonette fungus (pp. 301–303).—A brief account of variegation caused by the presence in the leaves of *Cercospora resedæ*, often resulting in the complete destruction of plants. The same treatment as for blights of variegated plants is recommended.

Secondary spores in anthracnoses (pp. 303–306).—Investigations were conducted to ascertain the exact nature of the special cells, or secondary spores, found growing on the hyphæ of some anthracnoses. The exact nature of the bodies is not positively known, but their thick walls suggest it is a protective phase. They are common to *Colletotrichum* and *Glœosporium*, and no distinguishing characters were observed between the two genera.

Some fungus diseases of the quince fruit (pp. 307–321).—A reprint of Bulletin No. 91 of the station (E. S. R., vol. IV, p. 656).

A study of fruit decays (pp. 322–333).—A summary is given of the more common decays of fruits. A laboratory study was made, using only the anthracnoses, and numerous cultures and inoculations were made within groups and from individuals of one group to those of another. A graphic diagram is given, showing the inoculations made. The author is inclined to believe that from his studies evidence is shown that there are less species of anthracnose than commonly given, but they may vary slightly with their hosts. Fifteen hosts wese used, as follows: Apple, peach, banana, pepper, bean, persimmon, lemon, watermelon, quince, citron, grapes, tomato, eggplant, pear, and squash. Some of the inoculations as given are very interesting, as from the apple to eggplant, bean to pear, grape to tomato, etc. Previous abstracts of this paper are given in Bulletin No. 16 of the Office of Experiment Stations and E. S. R., vol. IV, p. 399.

The treatment of fungus diseases (pp. 333–342).—A partial reprint of Bulletin No. 86 of the station (E. S. R., vol. III, p. 878).

Fungi injurious to weed seedlings (pp. 342–345).—The author examined a large number of weed seedlings and found that many of them are infected through the seed or early in the existence of the plant, probably through the cotyledons. Many plants are destroyed in this way.

Weeds and their most common fungi (pp. 345–349).—A list of 89 species of weeds, arranged in botanical order, with the most common fungi living on each, is given.

Nematodes (pp. 381–386).—Notes on nematodes in the roots of roses and violets are given, with suggestions as to probable means for their repression. Foliar nematodes are reported as destroying the leaves of an ornamental fig, *Ficus comosa.*

Methods of preventing smut of wheat and oats, C. P. Fox (*Idaho Sta. Bul. No. 4, July, 1893, pp. 3–6*).—A popular bulletin on the subject of treatment for smut of grain. Detailed information is given for the treatment of seed with blue vitriol and by the Jensen or hot water treatment. The annual loss to the oat crop due to smut the author puts at one fifth of the total yield, or about $50 to every farmer in the State.

ENTOMOLOGY.

Report of the entomologist of New Jersey Station, J. B. Smith (*New Jersey Stas. Report for 1892, pp. 389–512, figs. 49*).

Synopsis.—General review of the year's work, insects in crop bulletin for 1892, spraying for insect pests of the orchard, cranberry insects, the corn worm, rose chafer, smaller vine chafer, elm-leaf beetle, blackberry and raspberry insects, sweet-potato insects, and insects injurious to cucurbits.

General review (pp. 389–398).—Brief popular notes are given on the investigations of the year. The following insects are reported upon as having been more or less troublesome during the season: Curculio, codling moth, pear-tree mite (*Phytoptus pyri*), corn bill bug, cutworms, cranberry insects, cabbage root worms, cabbage worms, potato bug (*Doryphora 10-lineata*), corn worm (*Heliothis armigera*), asparagus beetles (*Crioceris 12-punctatus* and *C. asparagi*), rose bug or rose chafer, lesser vine chafer, elm leaf beetle, quince curculio (*Conotrachelus cratægi*), Angoumois grain moth, raspberry and blackberry pests, and sweet-potato insects. The author recommends the use of arsenites for the repression of cabbage root worms.

Insects in the crop bulletin (pp. 398–400).—Brief notes on the occurrence of numerous insects and injury done by them throughout the State.

Spraying for insect pests of the orchard (pp. 400–408).—A reprint of Bulletin No. 86 of the station (E. S. R., vol. III, p. 878), giving popular information regarding the treatment of the codling moth, plum curculio, peach borer, apple borer, and plant lice, formulas for insecticides, and brief descriptions of spraying apparatus.

Cranberry insects (pp. 408–441).—A reprint of Bulletin No. 90 of the station (E. S. R., vol. IV, p. 564).

The corn worm (pp. 441–446).—A report is given of the corn worm (*Heliothis armigera*), being a continuation of the report given for 1890 (E. S. R., vol. III, p. 309). Since that time its ravages seem to have increased. The insect is figured in its various stages, and notes on its habits and remedies for its repression are given.

The rose chafer (pp. 446–448).—A brief report on the inefficiency of kerosene emulsion for the rose chafer (*Macrodactylus subspinosus.*) The experiments reported in Bulletin No. 82 of the station (E. S. R., vol. III, p. 171) were repeated, and confirmed the previous conclusion that kerosene emulsion was not effective against this insect.

The smaller vine chafer (pp. 449, 450).—Brief notes on the appearance of *Anomala lucicola*, with description and illustrations of the species. The use of arsenites in Bordeaux mixture is recommended as an effective means for their repression.

Elm leaf beetle (pp. 451–455).—A report of observations made on the elm leaf beetle (*Galeruca xanthomelæna*). According to Prof. C. V. Riley, there are two and sometimes three broods at Washington, D. C. The author finds but one in New Jersey, with rarely a small second brood late in the season. The use of arsenites is recommended for the repression of this insect.

Blackberry and raspberry insects (pp. 456–466).—Notes, descriptions, and remedies are given for the following: Red-necked cane borer (*Agrilus ruficollis*), blackberry crown borer (*Bembecia marginata*), raspberry leaf sawfly (*Selandria rubi*), strawberry leaf roller (*Phoxopteris comptana*), and blackberry cane sawfly *Phyllœcus trimaculatus*). Some of the above species were previously reported in Bulletin N of the station (E. S. R., vol. III, p. 705).

Sweet potato insects (pp. 467–475).—Reports are given on tortoise beetles, the reaping cutworm, and sweet potato flea beetles.

The tortoise beetles, or "golden bugs," are easily recognized by their color. They appear late in May or early in June, and where abundant may kill or seriously check the growth of the plants. Their early attacks upon the plants, just after setting out, make them very destructive. Later, when the plants have made considerable growth, they can readily withstand their attacks. Spraying the vines with arsenites in proportion of 1 pound to 175 gallons of water, with one pound of lime for every pound of poison, is recommended.

The reaping cutworm (*Carneades messoria*) has been very destructive to the newly set plants in some localities, eating them off just above the ground. This larva is a grass feeder, and fall plowing and previous clean culture will greatly reduce its numbers. Poisoned baits of grass or other food plants soaked in arsenites and used for a week or two before setting plants will rid the soil of nearly all the larvæ.

The sweet potato flea beetle (*Chœtocnema confinis*) has proved very destructive to the leaves of the sweet potato. Stocky plants overcome the check upon their vitality caused by the attack of these insects, while the weaker ones succumb. The insect and its work are described as follows:

The field had been set out before May 15, some of it, indeed, by May 1, and the beetles came on at once, most abundantly from the edges near the fences. They ate little grooves on the upper side of the leaves, at first parallel with and near to the larger veins, but afterward in every direction, yet never crossing a vein nor eating

through the leaf. The leaf tissue dies on each side of the grooves and becomes dry and brown, until the whole leaf is destroyed. In wet weather the leaves become black and decay. The eating done by the insect is quite characteristic, and unlike any other injury due to flea beetles with which I am acquainted. The insects themselves are not above one sixteenth of an inch in length, metallic bronze brown in color, with very coarsely punctured thorax, and with striated and punctured elytra or wing covers. The hind legs are very large in proportion to the size of the entire insect, and these enable it to leap about so actively. At this time, May 21, some beetles were already copulating; but I found neither eggs nor larvæ, nor did I find specimens on bindweed or on any other plant. The fleas are said to be always worse where a field is in sweet potatoes a second year, and that they are always first noticed along the edge of woods or near the fences, as though they came from these places. They are not to be found in the forcing beds before the plants are set out, and what beetles are seen there come in from the fields afterwards.

Neither eggs nor larvæ were found, although the author continued his search for them for nearly two months.

It seems certain that the insects come into the fields from the vegetation along the fences and along the edges of the woods, and the first recommendation is to burn over all this growth in early spring so as to destroy the shelter thereby afforded the beetles. Cultivate close to the fences, and kill off, if possible, by a free use of salt or otherwise, all newly starting plant life.

When the plants are pulled select stout, stocky shoots only, and these should be dipped, before being set out, into a strong tobacco decoction—say, 1 pound of chopped stems or refuse steeped in 1 gallon of hot water and cooled gradually; or into water in which London purple or Paris green has been mixed at the rate of 1 pound to 175 gallons, lime equal to the weight of the poison being added. Tobacco is repugnant to most flea beetles, is effective against those infesting the white potato, and will probably be found useful in this case also. The arsenites are effective, of course, and will kill all the beetles that eat of them at the end of from thirty-six to forty-eight hours. This dipping should protect the plants until they are rooted and have started growth, when they will be safe. Should it become necessary they can be easily and rapidly sprayed as directed for the tortoise beetles, except that the surface only need be poisoned. Where there is an objection to this course a fair degree of immunity can be obtained by using plants with the greatest number of leaves along the edges of the field, and setting two in a hill, so as to distribute the attack and lessen injury in this way. The excess of plants can be very easily removed when they have started growth, and the better can be left standing.

Insects injurious to cucurbits (pp. 475–512).—The boreal ladybird (*Epilachne borealis*) occurred in sufficient numbers to be of considerable damage. It is the only exception in the State to ladybirds being beneficial through their carnivorous habits. It was briefly described in the Annual Report of the station for 1890 (E. S. R., vol. III, p. 309). The insect is fully described and its life history given. The use of arsenic sprays to which some lime is added is recommended.

The striped cucumber beetle (*Diabrotica vittata*), previously described in the Report for 1890 (E. S. R., vol. III, p. 309), is again described and its larva figured. A summary of remedies is:

(1) Plant under glass, in baskets, and set out after the vines are well started.

(2) Plant an excess of seeds, so as to distribute insect attack, and thin out when the danger is over.

(3) When plants are established and the beetles appear in dangerous numbers spray with the arsenites, or dust with the arsenites and plaster or dry slaked lime.

The squash bug (*Anasa tristis*) has proved troublesome, especially in gardens or where plants are few. The insect is described and figured. In fields the repression of these insects is accomplished by preventing their going into hibernation, through burning the vines as soon as the crop is gathered or plowing under early in September. In gardens hand picking must be depended upon. No rubbish should be permitted to remain where they can be sheltered.

The melon louse (*Aphis cucumeris*) is mentioned as the most injurious of the insects attacking cucurbits. It is briefly described in the Annual Report of the station for 1890 (E. S. R., vol. III, p. 309). A record of numerous field observations is given, together with what is known of the life history of the insect. The following are suggested as methods of treatment to be adopted in melon fields:

It is fairly certain that there is a migration from some outside point to the melons in June, and there is no evidence that there is any later migration, except from plant to plant within a single field, or to adjacent fields. By checking the spread of the insects at their first appearance practical exemption for the season may be obtained. Fields should be gone over carefully at least twice a week, beginning early in June, and every leaf at all curled or abnormal in appearance should be examined. If aphids are found the leaf containing them should be destroyed; or if a vine is at all badly infested, it will be better to pull and bury it, tramping the earth down well above it.

Should the insects be overlooked until they have begun to spread the plants should be very thoroughly sprayed with the kerosene emulsion, * * * whale-oil soap, * * * or fish-oil soap.

The squash borer (*Melittia ceto*) was described in the Annual Report of the station for 1890 (E. S. R., vol. III, p. 309) and in the Report for 1891 (E. S. R., vol. IV, p. 56). It is reported as having been abundant and destructive during 1892. A description, with illustrations, life history, and suggestions for its repression are given. Recommendations for field practice are given as follows:

(1) Manure or fertilize heavily and evenly; not in the hills only.

(2) Plant the land to summer squashes, preferably crook necks, as early in the season as feasible. If the fruit can be marketed to advantage a full set can be planted; if not, a few rows only will answer as traps.

(3) Plant the Hubbards, Marrowfats, or other main crop as late as advisable without risking the crop, making the hills between those of the early varieties.

(4) Keep a lookout for the moths, and when they are noticed go over the field every evening during the twilight and kill all that are found sitting on the leaves. A little practice will enable one to cover three rows at one time without missing a specimen, and in less than an hour a large field can be cleared of moths.

(5) When the late varieties need the ground the crook necks will have made at least a partial crop, even if badly infested by borers, and the vines can be removed, leaving the ground to the later varieties. This should be done carefully, so that all the borers remain in the vines, and the latter should be thoroughly destroyed in some way that will kill all the contained larvæ.

(6) As soon as the late vines begin to run well, they should be covered at the fourth joint, or even beyond it, and the ground should be kept in such condition that they can readily send down suckers from all the joints. This will enable the vine to resist injury and to ripen fruit, even if it becomes infested by a few belated borers; but there must be plant food enough where these joint roots are sent down, for that in the hill may be cut off.

(7) When the crop is made, the vines should be at at once removed and destroyed, as were those of the summer squashes, so as to prevent the maturing of any borers then in them.

In gardens hand picking and layering at the joints will usually suffice. If the vines become infested by borers, the latter must be cut out.

Insects injurious to cucurbits, J. B. SMITH (*New Jersey Stas. Bul. No. 94, July, 1893, pp. 40, figs. 15*).—A reprint from the Annual Report of the station for 1892 (E. S. R., vol. v, p. 404).

The four-lined leaf-bug, M. V. SLINGERLAND (*New York Cornell Sta. Bul. No. 58, Oct., 1893, pp. 207–239, figs. 13*).—The bulletin consists of an account of the previous history, destructiveness, and distribution of *Pœcilocapsus lineatus*, together with details of its life history and methods for preventing its ravages, with its bibliography and synonomy.

This pest was discovered in 1798, but it is only within the past three years that it has become especially troublesome. During 1892 at the station it was so destructive to currant and gooseberry bushes that by June 15 one half of the leaves on the new growth had turned brown and died. During the past season the bugs were not so numerous, but judging from the number of eggs laid they will probably be quite troublesome next summer.

In New York this insect was first reported in 1854 and has been recorded from various localities since that time. Its early ravages seem to have been most destructive to dahlias, blighting their buds and preventing their blooming. Its range now extends from Canada to Georgia, along the Atlantic coast and west through the north central States to the Rocky Mountains, but New York and Michigan seem to have suffered most from its presence. It has been reported as feeding upon 54 species, representing 31 different families of flowering plants, being most destructive to all kinds of currants, gooseberries, dahlias, and roses. The presence of the pest is indicated by the appearance of peculiar brown depressed spots on the tender leaves. As the attack continues, the leaves turn brown, curl, become brittle, and are torn or broken by the wind. The young shoots are checked in their growth or droop and die. With dahlias and roses the buds are often blasted. The insect is described as follows:

The immature forms, called nymphs, when first hatched are about 1.3 mm. (0.05 inch) in length. They are easily recognized, however, on account of the shining vermilion red color of the body marked with large blackish spots on the thorax. The antennæ and legs are of a greenish-black color. The nymphs grow quite rapidly, casting off their skin five times and undergoing considerable changes in markings. The body retains the same vermilion red color until the last nymphal stage is reached. The large black spots on the thorax of the newly hatched nymphs are seen to be the beginnings of the wing pads, which gradually become more and more apparent at each molt. The full-grown nymph is of a bright orange yellow color and measures about 5.5 mm. (0.21 inch) in length. Their black wing pads, which now have a broad yellowish-green stripe near the outer margin, are very conspicuous and extend nearly half way to the end of the abdomen, which is also marked

with black. The eyes are prominent and of a dark reddish-brown color. * * * At the fifth or last molt the adult insect appears. * * * The general color of the body [of the adult] is bright orange yellow; the legs and the portions between the black stripes on thorax and wing covers are of a dark apple green color, which usually changes to a lemon yellow after death. The wing covers are mostly of a leathery texture; the black caudal portion, which slopes downward at an angle of about 45 degrees, is membranous, with the exception of a triangular green portion, that usually has a small black spot near its center. The prominent eyes are of a very dark reddish brown color. The sexes are easily distinguished.

The life history of the pest is as follows:

Several of the recently hatched nymphs were isolated in cages in the insectary and their development watched. It was found that they molted (or cast off their old skins for new elastic ones which formed underneath the old) five times, or passed through five nymphal stages before the adult stage was reached.

During the first three stages the whole body is of a vermilion red color, with the legs and antennæ blackish-green; the last antennal joint has a distinct reddish shade and is slightly enlarged. In the fourth and fifth stages the distal half of the second and all of the third and fourth joints of the antennæ are black; the last joint becomes slenderer and the basal portion of each antenna and the legs are of a light yellowish green color with two irregular bands of black across the dorsal aspect of each femur; and a yellowish green stripe appears on each wing pad. In the fourth stage the head and first thoracic segment are orange yellow in color, and a day or two after the fourth molt the whole body is of a similar color with irregular lighter yellowish stripes between the rows of black spots on the abdomen. In all the nymphal stages hairs occur on the head and arise in rows from black spots on each abdominal segment. In all stages of the insect, including the adult, the antennæ are thickly set with black hairs, and as each joint is lighter at its extremities they have a ringed appearance; the legs are set with many short black spines; the eyes are always prominent and of a dark reddish-brown color; the tip of the beak is black and a large black spot occurs on its base.

The newly hatched nymph measures 1.3 mm. (0.05 inch) in length. The first molt occurs in three or four days.

The second nymphal stage lasts three days and the insect attains a length of 2.1 mm. (0.08 inch).

After its third molt the nymph increase in length to 3 mm. (0.12 inch) and the fourth molt occurs in from two to three days.

The fourth stage is passed in from five to seven days and the nymph then measures 3.7 mm. (0.145 inch) in length.

The insect reaches its fifth and last nymphal stage, the pupa of some authors, in from thirteen to fifteen days after leaving the egg. The duration of this stage is from four to five days and the nymph measures 5.5 m. (0.21 inch) in length when the final or fifth molt occurs, at which the adult insect appears. Thus the nymphal stage of the insect is passed in from seventeen to twenty days.

The adults first appeared this year about June 13. This agrees with most of the recorded dates of their first appearance.

Nearly all writers in speaking of the lighter stripes between the prominent black ones describe them as bright lemon yellow in color; and no mention is made that they were ever any other color. But, as Dr. Fitch pointed out, they are of a bright apple green color in life. Only one specimen out of the many hundreds observed this season on the currant bushes had these stripes yellow in life. Occasionally the stripes retain their green color for several months after being placed in cabinets, but usually the change takes place in a few weeks, especially if the specimens are kept in the light.

The black spots caudad of the outer black stripes on the wing covers are often wanting or nearly so. Among 75 specimens collected this season, 29 of them, mostly

females, lack the spots. Thirteen of the specimens, mostly females, showed but little trace of the outer black stripes on the thorax; in some specimens both the stripes and spots were wanting. The black bands on the dorsal aspect of the femurs are sometimes obsolete, especially on the front legs.

The habits of nymph and adult are very similar. Both feed by means of their beaks and are very shy, slipping to the underside of the leaf at the slightest alarm. The young seem confined to shrubby plants, while the adults feed on many herbaceous as well as shrubby plants. Hitherto nothing has been recorded regarding the oviposition of the female. The author has found the eggs in position. Egg laying began about June 22 and was ended about July 7. The eggs, 2 to 14 in number, are deposited in slits made in the new wood near the tip of the shoot, which extend through the wood into the pith. The eggs are 1.65 mm. (0.065 inch) in length, smooth, cylindrical, slightly curved or flask-shaped, and of a light yellow color with the upper third capped by a white, finely striated portion; the lower end is rounded and the upper irregularly flattened. With the growth of the surrounding tissue of the stem, the eggs are often partly forced out of the slit, so that half or more of the white portion protrudes. The eggs are usually deposited near the tips of the branches, seldom being found six inches from the tip. Two broods per year have been reported for this pest, but for New York the author finds but one. It hibernates in the egg.

A briefly stated summary of our observations upon the life history of the four-lined leaf-bug shows that the nymphs appear in the latter part of May upon shrubby plants where they continue to feed upon the tender leaves for two or three weeks, undergoing five molts. The adults appear early in June and often spread to different surrounding succulent plants. Egg laying begins in the latter part of June; the eggs being laid in slits cut in the stems of shrubs near the tips of the new growth. The adults disappear in July and the insect hibernates in the egg. Only one brood occurs each year in our State.

Particular attent on was paid to the use of remedies for the destruction of this pest. The following summary gives the author's suggestions:

The arsenites and other poisonous insecticides will have no effect on the bugs, as they feed solely upon the interior juices of the plant. The only other insecticide that promises good results is kerosene emulsion diluted with five parts of water and applied on the nymphs as soon as they appear in May. It will, perhaps, not be so effective on the adults. On large areas we believe it will prove a practicable means of fighting the pest while in the nymphal stages.

The burning of the garden rubbish in the fall will not affect the pest in the least, nor will there be any gravid females to watch for and destroy in the spring, as the pest winters in the egg securely placed near the tips of the new growth of shrubs.

The pruning and burning of these tips in which all of the eggs are laid will prove a practicable and very efficient means of fighting the pest. The pruning can be done at any time between the first of August and the first of May following.

Probably the best method for general practice, especially against the adults on herbaceous plants, will be to capture the bugs by jarring them into a dish partly filled with kerosene and water. On currants, gooseberries, sage, and other shrubs one should not wait until the adults appear but capture the nymphs in May.

Thus, there are three practicable methods by which this pest can be controlled: Kerosene emulsion for the nymphs, destruction of the eggs by pruning, and the capture of the nymphs and adults by jarring into receptacles where they are destroyed. Circumstances will largely determine which method will prove the most practicable in specific cases.

The bulletin concludes with a quite extensive bibliography and synonomy.

Insects beneficial and injurious to the orange and other citrus fruits, H. A. MORGAN (*Louisiana Stas. Special Bul., pp. 51–110, plates 3, figs. 36*).—Popular notes, descriptions, and illustrations are given of the injurious and beneficial insects, together with suggested means for the prevention of the ravages of injurious insects. Attention is called to the confusion caused by the wrong use of common names, and the necessity of correct determinations and the use of scientific names is urged. Of the injurious insects already known within the State the following scale insects are described, their life history given, and most of them figured: *Mytilaspis citricola*, *M. gloverii*, *Aspidiotus ficus*, *Parlatoria pergandii*, *Chionaspis citri*, *Ceroplastes floridensis*, *Lecanium hesperidum*, *Dactylopius destructor*, and *Aleyrodes citrifolii.* Of the destructive scale insects to be expected in the State the following are described: *Aspidiotus citrinus*, *A. aurantii*, *A. nerii*, *Lecanium olea*, *Ceroplastes cirripediformis*, and *Icerya purchasi.*

Directions are given for the preventive and remedial treatment of trees affected with scale insects. A remedial treatment consists in the use of kerosene and rosin emulsions, hydrocyanic acid gas, and parasitic and predaceous insects. Formulas for the preparation and directions for the application of the insecticides are given.

The following predaceous insects are figured and described as enemies of the scale insects: Two-stabbed ladybird (*Chilocorus bivulnerus*), blood-red ladybird (*Cycloneda sanguinea*), *Hippodamia convergens*, and small laced-winged fly (*Chrysopa oculata*).

Illustrations, descriptions, life histories, and remedies are given for the following additional insect pests of citrus fruits: The rust mite (*Typhlodromus oleivorus*), orange aphis (*Siphonophora citrifollii*), the green soldier bug (*Raphigaster hilaris*), and the orange dog (*Papilio cresphontes*).

Notes are given on a smut fungus (*Capnodium citri*) and the Mexican fruit fly (*Trypeta ludens*).

The periodical cicada, J. B. SMITH (*New Jersey Stas. Bul. No. 95, Sept., 1893, pp. 6, fig. 1*).—A popular description of the seventeen-year locust (*Cicada septendecim*). Four broods are recorded for that State, one of which may be expected next year. This is the most numerous and widely distributed brood of the State. With a view to lessening the amount of injury liable to result from their appearance the following recommendations are given:

(1) That no pruning be done either during the present fall or next spring. This applies as well to shrubs as to trees, for the insects will oviposit in both, and their

pruning will probably be severe enough, though perhaps not so well judged as where done by the grower. By offering them a mass of twigs the damage will be so distributed that the plants will suffer no permanent injury.

(2) Do no budding or grafting either this fall or next spring. The chances are that all young shoots or grafted stock will be severely injured or destroyed by the insects. Sometimes vigorous young fruit trees overcome the effects of the punctures the first year, but usually lose the affected branches the year following, destroying the shape or making it necessary to cut back so as to lose a year or two in growth. By adopting the above simple precautions the amount of injury done can be lessened, if not entirely prevented.

Insects injurious to stored grain, M. H. BECKWITH (*Delaware Sta. Bul. No. 21, Sept., 1893, pp. 12, figs. 7*).—Popular descriptions and illustrations of the grain beetle (*Silvanus surinamensis*), granary weevil (*Calandra granaria*), rice weevil (*C. oryzæ*), pea weevil (*Bruchus pisi*), bean weevil (*B. obtectus*), four-spotted bean weevil (*B. 4-maculata*), and Angoumois grain moth (*Gelechia cereallela*). Bisulphide of carbon is recommended for use against all these pests. Directions for its application are given.

FOODS—ANIMAL PRODUCTION.

E. W. ALLEN, *Editor.*

Commercial feeds (*New Jersey Stas. Report for 1892, pp. 149–155*).—This includes analyses of upland and lowland meadow hay, crimson clover, cotton-seed meal, oats, corn, corn meal, wheat bran, wheat middlings, dried brewers' grains, wet brewers' grains, glucose meal, cerealine feed, and cocoa shells, and a statement of the average market prices of a large number of commercial feeding stuffs during the year. Extracts are also given from Bulletin No. 87 of the station (E. S. R., vol. III, p. 878).

The farmers of New Jersey pay directly to fertilizer manufacturers and dealers over $1,500,000 annually for just the same elements—though often in a less available form—that in the feeds are furnished them at so low a cost, and among the number so purchasing are a host of our best dairymen. If they have bought the right feeds and have fed them to the best advantage there can be no criticism of their work; if they have not it is strongly urged that they study these facts.

That farmers in other countries appreciate the importance of food and fertilizer values is abundantly evident when we study our export lists.

In 1890 we exported in round numbers 360,000 tons of oil meal. The market conditions made it possible for the producers to receive for it $8,000,000, and, based entirely upon feeding value, the consumers obtained an excellent feed at a low price. There was contained in that amount of oil meal, however, nitrogen, phospheric acid, and potash worth $8,000,000, based on a valuation for these elements much lower than consumers are on the whole obliged to pay for them in commercial fertilizers. If farmers appreciated this excellent feed as they should, not a pound would be exported.

Take the case of wheat bran and middlings, both excellent feeds from the standpoint of either food or fertilizer value. In 1891 there was exported 55,000,000

bushels of wheat and 11,000,000 barrels of flour; we received for the wheat $51,000,-000 and for the flour $55,000,000. At the rate of 5 bushels of wheat per barrel of flour the flour represented as much wheat as was exported directly, though we received for the flour $4,000,000 more than for the wheat. In addition, we retained bran and middlings, articles not used for human consumption and worth as stock feed, at the low valuation of $15 per ton, $10,000,000, and containing fertilizing constituents worth $8,000,000. The latter is a clear loss to us, and if added to that in the linseed meal, another product used chiefly as animal food, makes a total loss of $16,000,000 annually in these two exports alone.

On the other hand, we import annually over $100,000,000 worth of sugar, a product used for human consumption alone, and composed entirely of carbon, hydrogen, and oxygen. It therefore represents no loss of fertilizing value to our neighbors and no gain to us.

Feeding experiments with horses, E. B. VOORHEES and L. A. VOORHEES (*New Jersey Stas. Report for 1892, pp. 157–183*).—A reprint of Bulletin No. 92 of the station (E. S. R., vol. IV, p. 742).

Studies in oyster culture, J. NELSON (*New Jersey Stas. Report for 1892, pp. 207–271*).—This report of the biologist for the year includes an introduction, a report on the green clams of Tuckerton, and a description of the oyster exhibits at the World's Columbian Exposition. In the introduction the author points out the connection between agriculture and oyster culture, maintaining that the latter is decidedly a branch of agriculture as much as bee keeping or poultry raising. He describes his efforts to extend the crop reports to oyster culture, which failed, as sufficient volunteer observers could not be secured among the oystermen.

The green clams of Tuckerton (pp. 218–249).—Early in September, 1892, the author was informed by letter that—

An "infection" had appeared in Tuckerton Bay which caused the clams to become green; that this infection appeared locally at the southern margin of the bay about the middle of August, and that it had now largely extended its area; that clams that had been shipped as presumably good had been returned or had been refused by distant dealers because of their green color; that people supposed that either copper or some poison like Paris green had gained access to the clams and caused the color, and not a few supposed that they had been infected with cholera germs, or at least were provocative of such disease in man.

This "infection," it was stated, threatened the oyster and clam interests of Tuckerton, which for that year were valued at about $100,000. After an investigation the author reported as follows:

The color is due to the presence of a species of microscopically small vegetable organism which the dryness of the past summer allowed to multiply in the water on the beds, and which the clams have eaten in large quantities, so that their tissues have become stained by the color of their food. The dye is perfectly harmless. Numerous tests and analyses made by several scientists both of this country and Europe show that copper is not present; neither does microscopical examination show any disease nor any parasites present. Oysters affected in a similar way are in special demand in Europe, not for their color, but because of their careful cultivation, the fine qualities being in no wise deteriorated by the fact that their tissues are stained by their food.

The author prepared a circular to this effect to be sent by oyster dealers to their customers in the hope of overcoming the prejudice against green clams. A chronological résumé is given of the literature relative to the greening of oysters and other mollusks. Some of the deductions from this are presented below:

In the first place, all the investigators are agreed that oysters and clams colored green in this way are not injured as an article of diet, and indeed may often be superior. * * *

But, as we know, all uncultivated and poor oysters in America are not green, neither are all the green oysters of Europe good. It is cultivation—lengthy culture—that improves the oyster, while the greenness may be secured in a few days or lost in a few days. This point should be thoroughly understood by oystermen. It is, therefore, an accident that in one locality the greenness of an oyster is a sign that it is poor, while in another locality it is taken as showing culture and fatness. These two points, viz, that greenness is not of itself a poison, but is harmless, and that it is not an indication either of a poor or of a good oyster, may be advanced as certain, and constitute the practical side of the question, which both producer and consumer should understand. The other points in the controversy are mainly of scientific interest.

First in order is the question of the origin of the color. The historical résumé shows that this question is pretty definitely solved, viz, it is derived from coloring matters in the food of these mollusks. What is this coloring matter? * * * Why, when greening does occur, are some organs affected and others not? Here I believe I have made an important discovery, viz, the green stain is found only in that sort of protoplasm which is undergoing rapid metabolism. This is stating it on the physiological side. Morphologically speaking, the green color is confined primarily to the ciliated tracts of the animal, possibly also in the gland cells, and in the amœboid corpuscles. * * * A cell undergoing metabolism is like a whirlpool receiving constant additions of new matter and throwing this matter out of itself again, but (in the case of the cell) in a chemically changed form. From the blood towards such a cell is an ingoing stream of fluids containing gases and substances in solution, and from the cell to the blood is a return current laden with waste products, secretions, and excretions. If the ingoing current contains a stain, the whirlpool will be stained. When the ingoing current is clear, the stain already in the cell will be removed by the outgoing current.

General report on the Columbian oyster-culture exhibit of the Agricultural College Experiment Station (pp. 249–271).—The exhibit is classified as follows:

(1) Natural history of oysters and clams and bivalves in general; (2) enemies, friends, messmates and companions of oysters; (3) collectors or cultch—materials upon which oyster "spat" fastens; (4) natural oysters or oyster "seed," used by "planters" for cultivation on the "farms;" (5) artificially raised oyster "seed," secured by planting oyster shells, etc., as "cultch;" (6) cultivated oysters, *i. e.*, "seed" from whatever source, after it has been cultivated one or more years; (7) technique and methods of oyster culture, especially experimental methods; (8) charts, tables, photographs, statistics, literature, etc.

A detailed description of the exhibit is given.

VETERINARY SCIENCE AND PRACTICE.

J. F. DUGGAR, *Editor.*

Anthrax, A. T. NEALE (*Delaware Sta. Bul., No. 20, pp. 15*).—The following topics are treated: History of the anthrax epidemic of 1892; proof that the disease was anthrax; the nature of anthrax; means by which the disease was introduced into Delaware; fatality; and means for checking the spread of the disease.

During the summer and fall of 1892, 40 cows and 9 horses are known to have died of anthrax on ten farms in Delaware, and four cases occurred among the owners of the cows. Bacteriological observations revealed the presence of the anthrax bacillus. It is stated that the disease was probably introduced into the State by means of drovers or by skins from foreign countries used in morocco factories. Several outbreaks of anthrax in Germany are discussed in order to show how these so-called "wild skins" carry the contagion. In the immediate neighborhood of the farms infected in 1892 skin scraps and hair from morocco factories had within two or three years previous been used in composts. Even the use of lime from morocco works as a manure is not considered thoroughly safe, since this contains hair, sweepings, and skin scraps. Whenever anthrax is suspected, peat and similar dried swamp litter coming from lands subject to overflow from streams which run near tanneries, woolen mills, slaughter houses, or bone-boiling establishments, should be avoided.

Anthrax may also be carried on the boots or clothing of a person who has examined a carcass, and during such examinations the disease may be transferred to man. The relation of buzzards to the spread of this disease is now being investigated by the station. At the time of an epidemic all carrion likely to attract buzzards should be burned or buried and the ground under buzzard roosts should be regarded as a possible point of contagion.

The carcasses of animals dying of this disease should be burned, or, if this is impracticable, deeply buried in an isolated place. Protective inoculation has been extensively practiced in Australia and is now under investigation at the station.

Tuberculosis and the Koch test, E. P. NILES (*Virginia Sta. Bul. No. 26, March, 1893, pp. 55–60*).—A popular discussion of the nature of tuberculosis and the means by which it is spread is followed by tabulated data giving the temperatures of the animals of two herds after inoculation with tuberculin. In the station herd of 54 cattle only one gave a notable increase in temperature after inoculation. Though this animal was apparently healthy and showed no physical symptoms of the disease, yet upon post-mortem examination tubercles of considerable size were found in the lungs, liver, and intestines. Two other

animals showed a slight elevation of temperature, but when, two weeks later, a second test was made no characteristic reaction took place. A herd of 38 head of cattle belonging to the Miller School was also inoculated. The table of results shows that only one animal gave the characteristic reaction, and the existence of the disease in this instance was confirmed by a post-mortem examination.

Southern cattle plague (Texas fever), F. S. BILLINGS (*Nebraska Sta. Bul. No. 28, March, 1893, pp. 111, plates 2, figs. 8*).—This is the third report of the author's investigations on Texas fever. The bulletin consists in part of a reprint of Bulletins Nos. 7, 8, 9, and 10 of the station (E. S. R., vol I, p. 123). The data given in those bulletins are further discussed. The new matter is chiefly controversial.

The results of inoculation experiments in the winter of 1891–'92 are also given. It is asserted that in ticks from Mississippi and in their excrement was found the bacillus to the agency of which the author attributes the disease; that pure cultures from the tick were used in inoculating two calves, a Guinea pig, and a rabbit; that one calf died; that the other sickened, but recovered; that both of the small animals died; and that the bacillus referred to was found in the blood of the Guinea pig and in that of the rabbit.

AGRICULTURAL ENGINEERING.

Irrigation experiments, J. W. SANBORN (*Utah Sta. Bul. No. 24, Aug., 1893, pp. 8*).—Plats (size not stated) drained to the depth of 2½ feet by stone drains which were 11 feet apart and emptied into water-tight vaults were irrigated with river water of known composition as follows: Sufficient water was applied to saturate the soil (1) to a depth of 1½ feet, (2) to a depth of 2½ feet, (3) to a depth of 3¼ feet, and (4) to a depth of 4 feet. The stated purpose of the trial was "to make an inquiry as to the influence of amounts of water, not only on the crops raised, which would be the practical side of the question, but upon the influence of the water upon soil fertility and also upon its direct influence as a supply of plant food." One series of plats treated as above described was seeded to wheat and another to timothy. The yields of these crops and the amounts and composition of the drainage water from the different plats are tabulated and discussed. The general conclusions arrived at are as follows:

(1) The best yield of grain was secured where water was applied sufficiently to saturate the soil 1½ feet deep.

(2) The best yield of grass was secured from the heaviest application of water.

(3) Drainage did not appear to result in an increased amount of moisture absorbed from the air.

(4) The lateral movement of water was very small.

(5) The water of Logan River furnishes a superabundance of lime, but only a very small per cent of the potash, nitrogen, and phosphoric acid required by crops.

(6) The Logan River water is entirely inadequate to maintain soil fertility. This is true of the water of other rivers analyzed at the station laboratory.

(7) Practically all of the plant food applied by irrigating water in sufficiency for crops is retained by soils; or ordinary irrigation does not leach fertility from the soil.

STATION STATISTICS.

Fifth Annual Report of Alabama College Station (*Alabama College Sta. Report for 1892, pp. 18*).—Treasurer's report for the fiscal year ending June 30, 1892, together with brief reports of the chemist, botanist, agriculturist, and veterinarian of the station.

Fifth Annual Report of the Louisiana Stations (*Louisiana Stas. Report for 1892, pp. 4*).—This includes very brief reports of the substations, together with the treasurer's report for the fiscal year ending June 30, 1892.

Report of Director of New Jersey Stations (*New Jersey Stas. Report for 1892, pp. 1–5*).—A brief review of the work of the several departments for the year and a list of the bulletins published by the State and college stations.

Report of Treasurer of New Jersey State Station, J. NEILSON (*New Jersey Stas. Report for 1892, pp. 23*).—A financial statement for the year ending December 31, 1892.

Legislation, station work, and publications (*New Jersey Stas. Report for 1892, pp. 515–534*).—This contains the acts of the State legislature relating to the station, fungus diseases of plants, the State Weather Service, and the inspection of fertilizers ; a catalogue of the bulletins issued by the stations from their organization to December 31, 1892; directions for sampling fertilizers and feeding stuffs, and the order of station work during the year.

Fifth Annual Report of New Jersey College Station (*New Jersey Stas. Report for 1892, pp. 535–539*).—This contains a brief statement regarding the organization of the station and the financial report for the fiscal year ending June 30, 1892.

ABSTRACT OF PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE.

The prairie ground squirrels, or spermophiles, of the Mississippi Valley, V. BAILEY (*Division of Ornithology and Mammalogy, Bul. No. 4, pp. 69, plates 3, maps 4*).—The species of spermophiles inhabiting the region covered by this bulletin are *Spermophilus tridecemlineatus*, *S. mexicanus*, *S. franklini*, *S. spilosoma obsoletus*, and *S. richardsoni*, popular descriptions and life histories of which are given. The stomachs of a large number of specimens were examined and tabular information is given of their contents. In addition to their eating large quantities of grain, their food habits show them to be great destroyers of insects. Their natural enemies are hawks, owls, weasels, foxes, coyotes, etc. Various artificial means are suggested for keeping them in check, as poisons, traps, guns, etc. Experiments are given with carbon bisulphide for their destruction, and the author recommends it as one of the best means of ridding a field of these pests. Detailed information is given of its use by correspondents of the Division, with almost unqualified success. It seems the cheapest and most effective destructive agent tried. The practice followed in some States of giving bounties for the destruction of spermophiles is condemned by the author as wasteful and as not securing any appreciable diminution of the pest. Maps are given showing the distribution of each species.

Suggestions for the establishment of food laboratories, EDWARD ATKINSON (*Office of Experiment Stations, Bul. No. 17, pp. 20*).—In this article the author advocates the establishment of food laboratories, for the study of the economical nutrition of man and the art of preparing food, in connection with the agricultural experiment stations of the United States. He urges that "there is yet no popular science of cooking; there is yet no common art of cooking; there is now widespread ignorance on the whole subject, resulting in a waste which is not only unprofitable but noxious in its influence on the general health of the community."

The art of cooking as now practiced is wholly empirical and to a great extent bad. Almost all rapid or quick cooking is bad cooking. The science of cooking, as I have stated, consists in the regulated application of the right degree of heat for a suitable time to work the true conversion of the raw food materials into nutritious food. If there is a variation of any considerable amount in either of these elements, *i. e.*, in the uniformity or degree of heat, or in the time of its application, the cooking will, as a rule, be bad. For instance, if animal foods are subjected to excessive heat, as they are apt to be in the frying pan and in the cooking stove, they become more

productive of dyspepsia than of energy. The development of a food laboratory may therefore be directed toward the right methods of preparation of the food of mankind. Unless that object is incorporated with the other work of the experiment stations, they may totally fail in their true object, which is the final conversion of the nutrients in food material to the nutrition of mankind.

As preparatory to these laboratories the first work indicated is the collation of what has already been done in this country and abroad, to render the results accessible. As to the kind of investigation desirable the author makes the following suggestions:

The lines of investigation which ought to be considered are, first, the best means to produce the highest amount of human energy with the least waste; that is to say, the best form in which food materials are to be consumed; how far can predigestion outside the body take the place of work done in the body without detriment to the machinery? Another line of investigation may be the following: If a simple, monotonous food is best for the animal, is a greater variety, and especially are stimulating flavors, better for the mental work of the human thinker than for the muscular work of the human animal? Or perhaps this problem might be reversed. May not the human animal be developed into a higher type of the human thinker by developing right methods in the choice of food and in its preparation? These are perhaps somewhat visionary suggestions. They are put in this form in order to give point to the suggestions submitted. Third, what is the relation of physical exercise, apart from work, to the nutrition of the body as an instrument of thought? The number of problems which may be presented for solution in this matter is very great. * * * The work, thus far, has been that of individuals, taken up in a disjointed way without any special system. The coöperation of a large number of workers, investigating on a common plan, is required.

The article concludes with a description of the New England kitchen in Boston, Massachusetts, which is cited as an example of a successful food experiment station.

Report of the statistician (*Division of Statistics, Report No. 110, n. ser., November, 1893, pp. 415–458*).—This includes articles on the following subjects: The estimated yields of corn, potatoes, hay, tobacco, sorghum, and buckwheat; and the prospects of cotton, apples, pears, and grapes; the imports of American wheat flour into Europe; the hop crop of England for 1893; the beet sugar production of Europe for the year 1893–'94; a summary of a monograph on agriculture in Great Britain and Ireland, by E. Clarke; notes from consular reports; and freight rates of transportation companies.

ABSTRACTS OF REPORTS OF FOREIGN INVESTIGATIONS.

The sexual reproduction of Ustilagineæ, P. A. DANGEARD (*Compt. Rend., 117* (*1893*), *No. 15, pp. 496, 497*).—The author calls attention to the fact that the phenomenon of fecundation is still unknown for many fungi, on which account many are considered as wholly without sexuality. The information embraced in the present paper was obtained in a histological study of the family *Ustilagineæ*, and the author thinks it an explanation of their reproduction.

The nuclei are very small, but in the more favorable cases there may be distinguished a membrane surrounding them and a nucleolus. The fecundation is accomplished in those cells which have been commonly considered as spores, but which in reality are the oöspores produced from the oögonia. In each swollen cell, at the beginning, are found two nuclei corresponding, one to the male, and the other to the female nucleus; the protoplasm of the cell becomes condensed; the two nuclei approach each other and upon contact blend into a single central nucleus; at the same time the surface of the condensed protoplasm forms a double wall, of which the exterior one frequently presents the projections and reticulations of the various genera and species. The primitive swollen cell corresponds to an oögonium and the spore which it contains is an oöspore. The condensation of the protoplasm is, in general, very slight and the membrane of the oöspore is found almost in contact with the walls of the oögonium. In that way the error originated of considering these organs as simple cells filled with spores. To those wishing to verify his observations the author recommends the use of *Ustilago receptaculorum*, a species in which the oögonium and oösphere may be readily recognized on account of their size, 13μ–17μ. The author has examined, among others, *Ustilago violacea*, *Doassansia alismatis*, and the genus *Entyloma*, all of which gave similar results to the one given above, and he thinks they affirm his proposition that the *Ustilagineæ* have a method of sexual reproduction.—W. H. E.

The valuation of arable soils on a scientific, statistical basis, G. THOMS (*Mitt. kaiserl. livländ. gemeinütz. oeken. Soc., 1893, No. 13, pp. 122, charts 7*).—This is the second communication by the author on this subject, the first* being published in 1888. The present paper deals with data obtained in the examination of 284 samples of soil collected in 1885 from 47 estates in the district around Dorpat. These soils were

*Inaug. Diss., Dorpat, 1838.

classified according to actual productive capacity and then submitted to chemical and physical analysis to trace, if possible, the relation between chemical and physical properties of soils and their agricultural value, with a view to instituting a more equitable system of taxation. The report is devoted to the following subjects: The geological characteristics of the region represented by the soil samples; a tabular representation with explanations of the relation between the quality of the soils and their chemical and physical analyses; graphic representations of the relation between yield, and depth of soil and its content of phosphoric acid, lime, potash, and nitrogen; methods of taking and preparing soil samples, and of analyses; and a discussion of the question, Has the phosphoric acid content of the soils and subsoils of the Dorpat region increased or decreased under culture?

The conclusions drawn by the author from this work are as follows: The phosphoric acid content stands in direct relation to the quality of the soil, for a good soil contains a larger amount of phosphoric acid than one of medium quality, and the latter than one of the poorest quality. Moreover, the subsoils of the first class are richer in phosphoric acid than those of the second, and these again are richer than those of the poorer class.

The phosphoric acid content of the subsoil is, on the average, greater than that of the overlying soil; from which it follows that in the system of culture prevailing in the Dorpat region an increase and not a decrease of the phosphoric acid of the soil has, as a rule, taken place.

Not only as regards the phosphoric acid content, but also in respect to nitrogen, potash, and lime, does the best soil exceed that of medium quality, and this in turn that of poorest quality. The most marked relation, however, was observed in case of the phosphoric acid. The depth of the soil also bears a direct relation to its quality.

Contrary to what was observed in case of phosphoric acid and nitrogen, the subsoil was, on the average, richer in potash and lime than the corresponding upper soil.

The average figures for the physical properties—hygroscopicity, absorption of ammonia, water capacity, and proportion of sand and clay—vary so slightly for the good, medium, and poor soils that no marked relation to the productive capacity can be traced.—W. H. B.

The culture of autumn catch crops, P. P. DEHÉRAIN (*Ann. Agron., 19 (1893), No. 7, pp. 305–338*).—By means of pot experiments the author determined the amount of nitrogen escaping in the drainage water from soil left without any crop and from corresponding soil bearing autumn catch crops. The heavy rains of autumn leach out from the soil a large amount of nitrogen. As the average of the years 1890, 1891, and 1892, the author found that the loss per hectare was about 40 kg. of nitric nitrogen, equivalent to 250 kg. of nitrate of soda. These experiments and others have demonstrated that this loss can be reduced or entirely suppressed by sowing a catch crop immediately

after the removal of the main crop. For this purpose vetch or mustard is recommended. These plants, covering the soil, frequently take up all of the rainfall, so that there is no drainage water. But even when the drains are active catch crops diminish the loss of nitrogen.

In 1892 such catch crops yielded on an average about 15 tons of green material per hectare, containing 78 to 80 kg. of nitrogen. In the winter of 1891–'92 the loss of nitric nitrogen from soil without a crop was 15.066 kg. per hectare; from soil on which vetch was growing, 12.004 kg.; from soil on which a mixture of mustard and clover was growing, 6.072 kg. A crop of vetch growing in one set of pots was cut and turned under in another set of pots about the end of November, and the drainage water from the pots receiving this green fertilizer was compared with that from pots containing bare soil. Decomposition commenced during the winter, but was slight until February, so that from November 24 to February 9 the losses of nitrogen differed but slightly for the bare and for the treated pots. Not until late in February did the drainage water from the pots fertilized with this green manure become notably richer in nitrogen than that from the bare pots.

The loss from pots in which the vetch remained standing all winter, and from similar pots in which the crop was cut and removed in November, leaving only the roots in the soil, was determined. The pots with a standing crop lost from November 24 to February 9, 5.95 kg. per hectare; from the pots containing stubble the loss was 7.58 kg., showing but a small advantage in favor of leaving the crops standing all winter. However, when the losses just indicated are compared with the loss of nitrogen on the bare soil, viz, 16 kg., it is seen that both the standing crop and the stubble were of advantage in conserving the nitrogen of the soil.

During the following spring, summer, and autumn, the soil on which only the roots and stubble were left yielded to the drainage water 93.008 kg. of nitric nitrogen per hectare; where vetch grown on other pots was turned under in November the amount was 102.05 kg.; and where vetch was left standing during the winter and turned under February 5 the amount was 109.09 kg. The loss from the bare soil during this time was only 72.005 kg. These figures show that the following spring, summer, and fall the greatest amount of nitric nitrogen was furnished by vetch plowed under February 5, slightly less by the vines alone turned under in November, and still less by the stubble alone. However disposed of, the catch crop in every case furnished considerably more nitrogen the following season than was set free in the soil which had not borne an autumn crop. In the dry season of 1892, this excess of nitrogen did not become available till late in the year. The author recommends the turning under of catch crops late in autumn rather than in the spring, so that their nitrogen may become available in time for the usual farm crops.

On the pots which bore the catch crops of mustard and clover the green manure was not turned under till March 27, 1892. These pots liberated per hectare during the following spring, summer, and autumn 125.052 kg. of nitrogen, while the corresponding soil which had not borne a catch crop the previous autumn yielded up to the drainage water during this time only 72.005 kg. of nitric nitrogen per hectare.

The advantage of autumn catch crops is stated to consist in their storing up in autumn and winter the nitrates formed in the previous warm season, which without these plants would be lost in the drainage water of winter; and in the fact that the nitric nitrogen stored up by these plants reappears in the same form the following season, when it can be utilized by the ordinary farm crops.

The pots on which catch crops (entire plants) were turned under furnished an average of 45.008 kg. of nitric nitrogen per hectare in excess of that from the pots without green manure. This amount of nitrogen is equivalent to 300 kg. of nitrate of soda, valued at 69 francs (about $5.60 per acre), which more than pays the expenses of the catch crop.—J. F. D.

Potassium phosphate as a fertilizer, T. MEYER (*Chem. Ztg.*, *17 (1893), No. 70, pp. 1267, 1268*).—The desirability of a more extended use of this concentrated fertilizer is urged. Aside from its purity, this salt contains two elements of plant food in intimate combination, so that where a root hair finds a particle of phosphoric acid it finds at the same instant a particle of potash. This is of especial importance in time of drought. In potassium phosphate which is non-corrosive, and readily soluble in water, the farmer has an excellent top dressing with which—either alone or in combination with nitrate of soda—to hasten the growth of backward crops.

The general and extended use of potassium phosphate depends, however, upon its economical production. Probably the best method of preparation yet proposed is that worked out by the author and patented in Germany by H. and E. Albert, of Biebrich, which is substantially as follows:* A measured quantity of about 10 per cent phosphoric acid is poured out into a reservoir provided with a stirring apparatus; the sulphate of potash required to form potassium sulphophosphate, $KHSO_4\ KH_2\ PO_4$, is dissolved in the acid and the amount of chalk phosphate (the so-called *craie grise* of France and Belgium, containing 30 to 40 per cent of phosphate of lime and 40 to 50 per cent of carbonate) necessary to remove the sulphuric acid as gypsum is slowly added to the solution, with constant stirring. After about an hour the decomposition is complete, and the phosphate solution is separated from the residue of impure gypsum by means of a filter press. The solution is evaporated to a sirupy consistence and then kept in a chamber heated to 70 to 80° C. by means of steam until a dry, hard salt is obtained, which is easily reduced to powder in a disintegrator.

* See also Ztschr. angew. Chem., 1893, No. 21, p. 653.

The residue from the press, which contains a certain amount of insoluble phosphate, is placed in a second tank and treated with the sulphuric acid necessary to dissolve this phosphate, and again pressed. The solution thus obtained, together with the washings of the final residue, are conducted into the first reservoir to serve in the reduction of a second lot of phosphate. The final residue of gypsum is put on the market as a manure or manure preservative.

The salt thus prepared contains 38 to 40 per cent of phosphoric acid and 31 to 33 per cent of potash, and has been used with advantage on cereals, grapes, and strawberries.—W. H. B.

The development of the peanut, A. ANDOUARD (*Compt. Rend., 117 (1893), No. 5, pp. 298–300*).—Peanuts from an estate in lower Egypt were studied by the author. The roots were covered with tubercles. The author refers to a paper published by Eriksonn in 1874, denying the existence of tubercles on the peanut, and to a paper by Gain, showing that these tubercles form only in a moist soil.

The peanut grows quite slowly during the first half of its existence. Its most rapid period of growth is during the fourth month. All the parts of the peanut contain sugar. This reaches its maximum about the one hundred and fiftieth day, after which time the percentage of sugar is largely decreased in all parts of the plant. In the stalks and roots starch increases from the beginning to the end of vegetation, but in the fruit the percentage of starch constantly decreases.

The protein substances of the stalks and roots decrease at the flowering period, but in the fruit the increase in protein is constant. The non-protein nitrogen tends towards a maximum about the beginning of the fruiting period, afterwards decreasing, though at maturity the nuts still contain non-protein nitrogen. The fatty substances increase until the fruiting period, when in the vegetative organs they suddenly decrease. The increase of fat in the seed is rapid and continuous. The maximum of pectin compounds occurs between the sixth and ninth weeks for the organs of vegetation. The mineral elements are relatively abundant in the roots and stalks when the plant is young, afterwards decreasing.—J. F. D.

Studies on a new apricot disease, R. ADERHOLD (*Landw. Jahrb., 22 (1893), No. 3, pp. 435–467; abs. in Bot. Centbl., 56 (1893), No. 5, pp. 153–155*).—Apricot culture has been conducted in the vicinity of Mombach, Mentz, for sixty or seventy years. The trees are grown in a light, loose, sandy soil of reddish color and fine grain. The soil under and between the trees is cultivated with asparagus, tomatoes, beans, etc. For the past six years apricot culture has not been very remunerative, owing to an extraordinary disease. This disease makes its appearance every year in May after the first few warm, sunny, days. When it attacks a tree the tips and margins of the leaves become brown, dry, and dead. The dead portions seem disposed to curl up over the surface of the leaves. During dry weather the dead parts of the

leaves become very brittle and break away, leaving the leaf badly mutilated. A chance estimate gives at least 60 per cent of the trees of the district as affected by the disease. The epidemic character of the disease, its sudden appearance in the spring of the year, its annual return, and its gradual spread seem to indicate that it may be of fungus origin, and in the last stages of the dried leaves there is to be found a luxuriant fungus growth. The author has found present in nearly every case *Cladosporium herbarum* and a species of *Hendersonia.* Experiments were conducted to ascertain the relation between the two fungi, but with negative results. The *Cladosporium*, if taken from a dead leaf and placed in a nutrient solution on a green leaf, will in a few days cause the rapid dying of the leaf tissue, but if placed in water upon the leaf, it seems to have no effect. The author thinks the *Cladosporium* may possibly be the cause of the disease, although usually not a parasitic fungus. The *Hendersonia* is present as a saprophyte. It may be that the summer drought and drying of the leaves make it possible for the *Cladosporium* to attack the leaves.

Another view is that the disease is due to a lack of nutrition. The author reviews some of the work of such investigators as Kraus, Sorauer, Frank, von Thümen, and others, showing that the summer wilting of leaves is not due to the too intense sunlight and its accompanying heat, nor to an insufficient amount of water, but to a too scanty supply of nourishment. The soil of Mombach was analyzed for its lime and nitrogen content. There was found a normal amount of lime but an extraordinary deficiency of nitrogen. The total nitrogen was only about 0.0226 per cent, with scarcely a trace of nitric acid in solution. Risler and Colomb-Pradel have recently shown that at least 0.5 per cent of total nitrogen is necessary for remunerative tree culture. If this view be accepted the author thinks the lack of nitrogen may be the cause of the disease, and recommends the abundant use of manures rich in nitrogen, as a means for its prevention. He considers that the manuring of the trees will make them more resistant against all fungus attacks. Bordeaux mixture sprayed over the trees seems to be of no service in preventing the disease.—W. H. E.

Recent observations on brunissure (Plasmodiophora vitis), P. VIALA and C. SAUVAGEAU (*Montpelier and Paris, 1893, pp. 15; abs. in Bot. Centbl., 56, (1893), No. 1 and 2, pp. 55, 56*).—This disease first made its appearance in France in the autumn of 1892. It seemed to be found almost everywhere, but only in isolated cases was it very destructive. At first the injury was thought to be due to scale insects, but later to a fungus infection. It appeared very suddenly in the latter part of July and continued into October and November. The fungus causes a poor ripening of the grapes, a reduction in their sugar content, a lack of maturity in the vines, and the appearance of black or brown zones in the wood as far down as the roots.

The brown spots upon the upper side of the leaves at the beginning of the disease, are caused by the formation of brownish, tannin-containing, round masses in the epidermal cells. How these originate is not known at the present time. After a little while the epidermal cells become deformed, die off and expose the underlying parenchyma, and numerous white spots appear upon the dark background. The browning and suberizing of the cells passes through the leaf from the upper epidermis and at last appears on the lower side.

In the green cells at the beginning of the disease the existence of the parasite can often be made out by treating cross sections with absolute alcohol. Through many of the cells may be seen an amœboid mass, reaching as far as the plasma extends. In the brown and dried cells the network of the parasite can be demonstrated.

The method of propagation of the fungus and of the infection of the leaf has not yet been established.—W. H. E.

Two new diseases of mulberry, G. Boyer and F. Lambert (*Compt. Rend., 117 (1893), No. 8, pp. 342, 343*).—The authors have observed two new diseases of the white mulberry, one of bacterial origin and the other due to an undetermined fungus.

The bacterial disease, due to *Bacterium mori*, is especially destructive to young mulberry trees in the nursery, where it greatly checks the growth of the branches. The disease is externally manifest by the appearance of dark brown spots on the lower surface of the leaves and upon the branches. The spots on the twigs vary greatly, but are ordinarily oval, the longer diameter extending with the length of the branch. Frequently many of them run together, forming irregular patches of greater or less extent, and finally extending into the wood as far as the pith. Upon the leaves the spots appear along the veins similar to those upon the twigs. In the parenchyma the spots are small and through fusion form lesions of greater or less extent, which change from a rusty color to nearly black. The bacterium, living in the thickened tissues which it has destroyed, develops very rapidly. The disease has been produced upon the branches, parenchyma, and veins of the leaves by means of artificial inoculations. *Bacterium mori* has been isolated and cultivated upon solid media, where it forms hemispherical colonies at first white and hyaline, afterwards passing to yellow.

The disease due to the undetermined fungus is more common than the former one, and destroys a greater number of trees every year throughout the sericultural region of France. It attacks the buds and the leaves wither and dry up. The disease makes its earliest appearance upon the tips of the branches, extends to their base, and communicates with the principal branches, the trunk, and finally the roots. The various parts of the tree perish and the wood becomes more or less dark green in color. The author thinks these changes are due to the mycelium of the fungus which is found everywhere in the vessels

of the wood. The mycelium is variable, septate, branched, at first whitish, later yellow, and finally brown.

The two diseases are to be the subject of further investigation.—W. H. E.

Reports on experiments in checking potato rot (*Board of Agriculture, Great Britain, 1892, pp. 183, figs. 4; and 1893, pp. 97*).—Compiled notes are given on the use of fungicides for the prevention of potato rot (*Phytophthora infestans*). The experiments were conducted in England, Ireland, Scotland, Austria-Hungary, Belgium, Denmark, France, Germany, the Netherlands, and the United States. In most cases the experiments were conducted during the years 1890, 1891, and 1892, a few dating back to 1888 and 1889. In the first report notes are given on the history and cause of potato rot, with the life history and illustrations of the fungus.

The principal means employed for combating the rot was Bordeaux mixture, various formulas of which are given, in what are called 1, 2, and 3 per cent solutions. Other remedies were tried but not so extensively. The results obtained in England during 1891 were all favorable to the use of Bordeaux mixture. The amount used varied from 80 to 130 gallons per acre, and cost from $1.56 to $2.16 per acre for each application. Where the strongest solution was used, the foliage was sometimes injured. In a few cases there was a slight decrease in the yield, but usually there was an increase of from 7.7 per cent to 58.75 per cent, and in one case over 100 per cent.

In Scotland, Bordeaux mixture and a powder containing sulphate of copper were used, but with little effect. Heavy rains followed every application and they may have washed much of the fungicide away.

In Ireland experiments were begun in 1890 and repeated in 1891. The rot was very severe. The use of the Bordeaux mixture seemed to slightly increase the yield of potatoes, and although it did not prevent the rot, the potatoes from the sprayed vines seemed to possess better keeping qualities. In most cases the fungicide was employed as a curative and not as a preventive agent.

In Austria-Hungary the loss caused by potato diseases from 1884–'90 averaged 15.96 per cent of the entire crop. Experiments were conducted at Königsberg in 1890 with Bordeaux mixture, and they were so successful that Dr. Marek estimated that a saving of $9 to $10 per acre might be made by using Bordeaux mixture at a cost of $1.44 per acre.

From Belgium the results of extended experiments conducted by Caluwe, Petermann, and Thienpont are given, all of which are favorable to the use of fungicides. Bordeaux mixture, sulphate of iron solution, and sulpho-steatite were all tested, with a decided advantage in favor of the first. The best results were obtained from two or three applications as a preventive treatment. In nearly every instance an increased yield followed the use of the fungicides. The experiments

in 1891, reported by M. Thienpont, embraced over 2,500 acres. The quantity of fungicide applied varied, but M. Thienpont considers from 50 to 60 gallons per acre for the first application and 70 to 115 gallons for every subsequent one the best amounts to use. The applications were made at intervals of about three weeks.

In Denmark the series of experiments of Jensen seem to indicate that heating the tubers before planting will partially diminish the amount of disease by greatly retarding its appearance, and as a result, increase the crop. The use of Bordeaux mixture will also hold it in check. Jensen has pointed out the periodicity of the disease in Denmark from 1860–'91, and his observations have been confirmed by others in other countries.

From France the principal reports are those of experiments conducted by Girard and Prillieux. Girard's experiments extend from 1888 to 1891, and tend to show the great advantage to be secured by the use of fungicides. The amount of Bordeaux mixture used was about 150 gallons per acre for single applications, at a total cost of about $3. With this treatment M. Girard obtained gains for various varieties of from $10 to $25 per acre. In 1890 he investigated six fungicides and the effect upon them of artificial rain. Plants were grown in greenhouses, and after treatment with the fungicide they were subjected to artificial rains, representing a violent downpour, a heavy rain of six hours' duration, and a light shower of twenty-four hours' duration. Plants were analyzed before and after each rain. Bordeax mixture, to which molasses had been added, suffered least of all from the action of the rain. The violent downpour of 0.67 inches in twenty-two minutes was the only one causing any loss of the copper-molasses mixture. M. Prillieux was the first to use Bordeaux mixture for the potato rot, and his efforts were so successful that he considers it almost a specific for that disease if applied early enough. Other reports are given from France, all of which confirm the opinions of Girard and Prillieux.

From the Netherlands a 1½ per cent solution is reported on, showing quite an increase in the yield and a decrease in diseased tubers in proportion to the number of applications given.

From the United States reports are given of experiments conducted at the Wisconsin, Ohio, and Maine Experiment Stations, confirming the value of Bordeaux mixture as a preventive means for potato rot.

In addition to the reports on checking potato rot, extensive notes are given in the report for 1892 on potato culture as pursued in nearly all the larger potato-growing countries.

The season of 1892 was an unfavorable one for potato rot in Europe, except in a few localities. In England the experiments were carried on as before, to further test the efficiency of Bordeaux mixture, with results in the main corroborative of those given in the previous year's report. The experiments in England and Ireland tend to show that Bordeaux mixture, whatever formula is used, is preventive rather than

curative in its effect upon the disease. It was also shown that some varieties are much less liable to attack, and, upon the more resistant kinds, the fungicide sometimes produces an injurious effect. In England the addition of sugar or molasses, as suggested by Girard, proved of no advantage and only added to the expense. In Ireland, where the disease was rather troublesome, the efficacy of Bordeaux mixture as a preventive of potato rot was clearly shown, and no additional advantage was gained by the addition of molasses to the formula. In Belgium, M. Petermann found the preventive application of Bordeaux mixture highly beneficial in increasing the crop and lessening the amount of diseased tubers. He found, also, that the starch content of the treated potatoes was greater than in those whose vines had received no attention. He advises that the first spraying be given before any trace of the disease is seen, and one or two additional treatments at intervals of two or three weeks. In France, as reported in 1893, Girard experimented with a copper-soda solution with good results. It was not compared with Bordeaux mixture, so its relative value can not be given.

In Germany results seemingly opposed to each other are reported. Liebscher, whose results have already been given (E. S. R., vol. IV, p. 864), found that copper compounds decreased the yield of potatoes in 1892, due, he thinks, to a direct poisoning influence exerted on the plants during a dry season; and while copper is injurious to plants under certain conditions, he considers that it is still more fatal to the potato fungus, and should not be wholly condemned, but should be used with discretion. A series of experiments conducted at Dresden gave an increased yield of potatoes as well as an increased percentage of starch in the tubers, for those plats treated with Bordeaux mixture over all others. At Limbach the same experimenter sprayed a field of 22 acres, leaving a small portion, 1½ acres, as a check. Three applications were given with marked results. The August treatment, in this case, seemed most essential. Sorauer conducted an experiment to test the value of Bordeaux mixture as compared with sulpho-steatite, and the results given by most of the previous investigators were confirmed.

In general the conclusion, based on the foregoing reports, is that Bordeaux mixture is beneficial in combating attacks of potato rot. Care must be used in selection of chemicals and application of the mixture. No fixed rule can be laid down for the time of spraying or quantity to be used. The experimenter's judgment must tell him that. During dry seasons, when there is but little growth of the fungus, spraying may be injurious to some kinds of potatoes, but the beneficial effect upon those liable to attacks will usually more than make up for any loss. Bordeaux mixture does not wholly prevent attacks of the potato rot in especially bad years, but nearly all experimenters agree that it does diminish the per cent of diseased tubers and increase the total

yield. These factors, together with the increased starch content of the treated potatoes, will more than pay for the cost of treatment.—W. H. E.

The behavior of the phosphorus in the digestion of casein, E. SALKOWSKI (*Centbl. med. Wiss., 1893, pp. 385, 386; abs. in Chem. Centbl., 1893, II, No. 4, p. 222*).—It has been very generally stated that in the pepsin digestion of the casein of milk the phosphorus of the casein is separated as insoluble paranuclein. The author found, however, that the paranuclein contained only about 15 per cent of the phosphorus present in the casein, and that the greater part of the phosphorus was dissolved by the digestive fluid. The phosphorus content of the dry organic matter of this solution was accordingly only slightly less than that of casein itself. This phosphorus was in organic compounds. He points out the source of the error in previous observations which led to the belief stated above.

The author believes this discovery to have a physiological interest. As long as it was believed that in the digestion of milk the phosphorus in the casein was excreted as insoluble paranuclein, the object of the phosphorus in casein was not apparent. If, on the other hand, soluble phosphorus-containing digestion products result, it may safely be assumed that the phosphorus has a definite function to perform.—E. W. A.

Danish pig-feeding experiments, 1890-'92, F. FRIES and P. V. PETERSEN (*26de Beretning Kgl. Vet. og Landbohöjsk. Lab. f. Land. Ökon. Forsög, Copenhagen, 1892, pp. 100*).

Synopsis.—A report of experiments conducted on six farms with 344 pigs. Barley or rye was compared with wheat bran, and with different varieties of roots (mangel-wurzels and beets). Dairy refuse products were fed as additional feeds in all cases. Wheat bran was shown to possess a lower feeding value than grain (rye or barley) and to produce pork of poorer quality. Roots produced equally as good results as barley or rye, and the indications were that they might be advantageously fed to the extent of 40 per cent of the whole ration. The following quantities of different feeding stuffs were found to produce an equal growth with pigs, viz, 1 pound of barley or rye, 6 pounds of centrifugal skim milk, 12 pounds of whey from centrifugal creameries, 8 pounds of common mangel-wurzels, 4 pounds of potatoes, and 4 pounds of sugar beets.

The results of earlier experiments conducted at the Danish Agricultural Experiment Station indicated 1 pound of skim milk to be equivalent in feeding value for pigs to 2 pounds of whey, and 1 pound of grain (rye or barley) to be equivalent to 6 pounds of skim milk, 12 pounds of whey, 8 pounds of mangel-wurzels, or 4 pounds of potatoes.

The experiments here reported were conducted on six farms with 344 pigs, divided into sixty-six lots of 4 to 6 pigs each. The object was to study the feeding value of coarse wheat bran and of roots with different content of sugar and dry matter, as compared with grain (barley or rye). Buttermilk, skim milk, and whey were fed as additional feeds in all cases.

The plan of the present experiments was to feed in ten day periods, the amount of feed being determined by the owner of each estate or his representative. The relation between the different foods fed on the other hand, was the same for all estates, and had been previously decided upon. At the conclusion of the experiments the pigs were shipped to the nearest pork-packing establishment, where they were slaughtered, a representative of the station being present to take notes and make weighings. The carcasses and pork were scored to determine the commercial value of the pigs.

Wheat bran vs. rye or barley for pigs.—The experiments were conducted on five different farms, wheat bran being compared with barley on some farms and with rye on others. The pigs on each farm were divided into five equal lots, the separate lots receiving grain (barley or rye) or wheat bran alone or in various combinations. All the pigs received skim milk or whey. The trial lasted, on an average, one hundred and twelve days, and included a total of 115 pigs. In four out of the five trials the largest average gain was made by the lots on grain alone, which was quite closely followed by the lots receiving a mixture of 5 parts of barley or rye and 7 parts of wheat bran. Bran alone usually did not give as good results as a mixture of equal parts of grain and bran. The one sided bran feeding in several instances caused sickness among the pigs, while no sickness occurred in the other lots. As was previously shown for rye bran, wheat bran evidently has an appreciably lower nutritive value than barley or rye.*

The scoring of the carcasses showed that the pork produced on wheat bran was of poorer quality than that produced on barley or rye, and shrunk more in dressing, although the results were not so unfavorable to the wheat bran as those of previous experiments had been to rye bran.

Grain vs. mangel-wurzels for pigs.—In earlier experiments with roots for pigs it was found that 8 pounds of common mangel-wurzels possessed a feeding value fully equal to 1 pound of grain, and that the relative feeding values of grain, skim milk, and whey, mentioned above, (1:6:12), were not appreciably changed by the introduction of roots into the ration.

A preliminary feeding experiment with roots of different sugar content was made in 1890 to test their comparative feeding value. Mangel-wurzels, containing 12.71 per cent of dry matter and 8.93 per cent of sugar, were compared with fodder beets containing 19.86 per cent of dry matter and 13.8 per cent of sugar, and both were compared with barley.

The experiment lasted seven days and was conducted with 25 pigs, 5 in each lot, weighing about 79 pounds each. A constant quantity of skim milk and buttermilk was fed to all the pigs alike.

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* In comparative feeding experiments with Indian corn and rye or barley during 1889 the corn produced a slightly smaller increase in the weight of pigs than barley and a somewhat greater increase than rye.

It appeared from the results that the gain was somewhat larger on 8 pounds of mangel-wurzels than on 1 pound of barley, while the gain on 6 pounds of mangel-wurzels was less than on 1 pound of barley. Six pounds of mangel-wurzels did not give as good results as 6 pounds of fodder beets, while 4 pounds of the latter roots were fully equivalent to 6 pounds of the mangel-wurzels. The indications were that 1 pound of barley had a similar feeding value for swine to from 6 to 8 pounds of mangel wurzels and from 4 to 6 pounds of fodder beets.

The experiments with roots in 1891–'92 included four or five lots of pigs on each of six different farms. In all, 204 pigs were used. Four kinds of roots were compared, viz, Eckendorf and Elvetham mangel-wurzels, fodder beets, and ordinary sugar beets. All the pigs were fed buttermilk, skim milk, and whey. In addition, one lot received barley alone and one half of the grain of the other lots was replaced by roots. The pigs in the separate trials averaged about 50 pounds in weight. They were fed for from one hundred and twenty to one hundred and seventy days.

The following table gives a condensed statement of the average results on the six farms:

Average results of comparisons of grain with roots for pigs.

Food.	Food eaten per pig in ten days.					Average gain in weight per pig in ten days.
	Barley.	Roots.	Butter-milk.	Skim milk.	Whey.	
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Barley	25.9	None.	10	62.1	61.8	8.7
Barley and Eckendorf mangel-wurzels	13.4	97.4	10	62.1	61.8	8.3
Barley and Elvetham mangel-wurzels	13.4	81.7	10	62.1	61.8	8.4
Do	11.3	100.9	10	88.2	....	8.3
Barley and fodder beets	13.4	62.8	10	62.1	61.8	8.3
Do	7.2	93.9	10	62.1	61.8	7.7
Barley and sugar beets	12.5	50.1	10	36.0	61.8	8.1

It will be seen that the lot on barley without roots made the largest increase in live weight, closely followed by the lots half of whose grain was replaced by roots. The authors conclude that about 40 per cent of the daily ration of a pig may advantageously be made up of roots.

The data secured at slaughtering led the authors to conclude that the feeding of roots resulted in pork of good quality, and fully equal to that produced on the grain feed.

To show the relation between the food eaten and the gain in live weight in the above experiments, the food is calculated to a "grain standard," assuming 1 pound of rye or barley to be equivalent for feeding purposes to 6 pounds of skim milk, 12 pounds of whey, 8 pounds of Eckendorf mangel-wurzels, 6½ pounds of Elvetham mangel-wurzels, 5 pounds of fodder beets, and 4 pounds of sugar beets, respectively. The average amount of food calculated to this "grain standard" required to produce a pound of gain in ten series of experiments was, for different

stages of growth, as follows: Between 35 and 75 pounds live weight, 3.8 pounds of food; between 75 and 115 pounds, 4.4 pounds; and between 115 and 155 pounds, 5.3 pounds. The average between 75 and 155 pounds live weight was 4.8 pounds of food.—F. W. W.

On "soapy" milk and the source of bacteria in milk, H. WEIGMANN and E. ZIRN (*Milch Ztg., 22 (1893), No. 35, pp. 569–571*).—The authors give as the three principal characteristics of soapy milk the formation of froth, failure to sour, and a soapy taste. Trouble with soapy milk was experienced at the Kiel dairy school in November. The milk used is largely purchased from one farm. It was noticed that the butter was of inferior quality and no cause could be assigned. Soon the cause was discovered in the milk. After standing in the cans over night the milk had a sharp, pungent odor and a peculiar sweet taste. The milk could not be soured, but when kept in a warm place for several days instead of curdling it separated out a slimy precipitate. This fermented milk had a very offensive taste and odor. The cream did not ripen, even with a starter, and had a weak, disagreeable, acid taste. When churned a higher temperature than usual was required, and the cream frothed so that it ran out of the churn, although the latter was not filled more than a third full. The butter had a strong, unpleasant taste, and after keeping a few days could not be eaten.

Whole milk cheese made from such milk had but slight abnormal taste, but in skim milk cheese the taste was very noticeable.

Samples were taken of the milk of each cow in the herd and plate cultures made. With the exception of a single cow, the milk from all refused to clabber. The plate cultures revealed five species of bacteria, which were isolated and studied further. Among these one form was found to which the peculiar soapy taste of the milk was attributed. The bacteria of this form were fine rods with rounded ends, and on gelatin formed round white, slimy colonies with a yellow spot in the center, which gradually spread over the whole colony. Milk inoculated with this species became slimy after a few days and had an alkaline, soapy taste; in other words, became like the infected milk in every way. Another form was found which was believed to be responsible for the slimy precipitate which separated out of the milk on standing. The herd milk was almost entirely free from acid-forming bacteria, and contained principally those which either did not coagulate or had a rennet-like, peptonizing action. This accounts for the failure of the milk to clabber.

The source of this contamination was discovered in the straw used for bedding. It was noticed that this was moist in places and somewhat discolored, although it would not be regarded as spoiled or moldy. All five forms of bacteria found in the milk were found on the straw, and no other forms were found there. It was believed that the bacteria got on to the udder from the straw, and then fell into the milk during milking. When the use of the straw was discontinued and the

udders of the cows thoroughly washed, the trouble ceased gradually and the milk became normal.

Another case is mentioned in which the milk refused to sour and had a soapy taste, the cause of which was discovered in the hay. The same form of bacteria found in the first case on the straw was found on the hay. A similar trouble occurred in the spring when the cows were turned to pasture, but when the pasture was changed the trouble ceased.

Other cases are cited in which pasturage on a given piece of land gave similar trouble with the milk, while when the cows were moved to an adjoining piece the trouble disappeared. It is suggested that the cause of the contamination may have come through barnyard manure which had been applied.

It appears, then, that the food may not be without effect on the bacteriological composition of the milk. A frequent cause of contamination has been found to be the dust arising from hay and straw, especially when these are fed or used at milking time. Accordingly, the authors recommend that the cows be milked before being fed or bedded.—E. W. A.

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A study of the variations in the price of animals and of meat (*Étude sur les variations du prix du bétail et de la viande*), D. Zolla.—*Ann. Agron., 19 (1893), No. 10, pp. 449–486, diags. 4.*

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EXPERIMENT STATION NOTES.

Alabama Canebrake Station.—During the past season the station has made an experiment with fertilizers for sweet potatoes in which the yield ranged from 118 bushels per acre with no fertilizer to 122½ bushels with cotton-seed meal, and 126½ bushels with barnyard manure. The variety used was the Vineless potato, which was found to be a valuable variety of yam for table purposes and very prolific.

Idaho Station.—The station, which is located at the State University, has about 10 acres of land available for experimental work, and has in progress experiments with grass, forage plants, fruits, etc. It has at its command well equipped chemical, biological, and botanical laboratories; and an agricultural laboratory and one for the use of the domestic economist are to be provided. The station proposes to undertake work on domestic economy with a view to improving the quality and reducing the cost of food and devising labor-saving appliances for the household. Studies will be made on the preparation, digestibility, cost of production, and methods of preservation of food; and on the preparation of menus. Calculation of rations, tests of clothing material and of household machinery, experiments in household floriculture, etc., will be carried on.

Press Bulletin No. 1 is a popular bulletin for farmers explaining the object of the station and its facilities for doing work, and inviting coöperation between the station and farmers. Press bulletins are to be issued monthly. The station chemist will make a study of the potable waters of the Territory. Press Bulletin No. 2 explains this and requests samples of water to be sent for analysis, together with data of interest. A preliminary bulletin on the drinking waters of the Territory is soon to be issued.

Indiana Station.—F. W. McBride, assistant chemist of the station, has resigned and William Brody, a graduate of the class of 1887 at Purdue University, has been appointed his successor.

Kentucky Station.—Two new members of the governing board are W. L. Davis, of Paris, and D. C. Buell, of Paradise.

Minnesota College and Station.—A new building for use for offices, gymnasium, drill hall, and for manual training is being erected at a cost of $30,000. W. M. Hays, of North Dakota Station, has been elected professor of agriculture, and Thomas Shaw, of Guelph, Ontario, has been elected professor of animal husbandry. The School of Agriculture opened October 10. Its facilities were greatly increased during the summer and the school is now in excellent condition. Christopher Graham, veterinarian, has resigned his position, and Dr. M. H. Reynolds, of Keosauqua, Iowa, has been elected as his successor.

Montana Station.—The station staff is at present composed as follows: S. M. Emery, director and horticulturist; L. Foster, agriculturist and botanist; F. W. Traphagen, chemist; W. L. Williams, veterinarian; and H. G. Phelps, accountant.

Nebraska Station.—Among the forthcoming bulletins, one on wheat and another on grasshoppers, will appear soon. A chemist and an investigator of animal diseases are soon to be appointed.

New York State Station.—Wendell Paddock, B. S., has been appointed assistant horticulturist. The greenhouses just completed will be used this winter chiefly for experiments in forcing vegetables.

NORTH CAROLINA STATION.—R. E. Noble, third assistant chemist, has resigned to accept a position in the Alabama College Station; W. M. Allen has been appointed to fill the vacancy, and C. B. Williams has been appointed fourth assistant chemist.

TEXAS STATION.—Substations have been established by State appropriation at McKinney, in the "Black Land" region, and at Wichita Falls. J. H. Ferguson is superintendent of the former and J. W. Phillips of the latter. At McKinney 215 varieties of wheat and about 25 grasses have been sown. Wheat was sown on 30 plats to test the fertilizer requirements. Subsoil and rotation experiments have been undertaken, and tests of varieties of oats, barley, rye, cotton, corn, and potatoes are already in progress, or will be undertaken the coming season. Studies of grasses will form an important feature of the work of this substation. At Wichita Falls experiments with wheat, other small grains, and forage plants are under way. Special attention will be given to work on cereals. A substation for horticulture is to be established at an early date in southwest Texas. Experiments on the grape, semi-tropical fruits, vegetables, and small fruits will command the attention of this substation.

UTAH STATION.—The first Farmers' Institute ever held in the Territory was held under the auspices of the station at Taylorsville, November 13 and 14. A good number of farmers were present and much interest was shown. The meeting has already given rise to requests for other institutes which will be held.

WASHINGTON STATION.—The station staff as reorganized is as follows: E. A. Bryan, director; E. Fulmer, chemist; E. R. Lake, agriculturist and horticulturist; and C. V. Piper, entomologist. Director Bryan is also president of the college, succeeding J. W. Heston.

WEST VIRGINIA UNIVERSITY.—F. W. Rane has been appointed professor of agriculture in the university in addition to his duties as horticulturist to the station.

WISCONSIN UNIVERSITY AND STATION.—The station has added to its working force H. L. Russell, PH. D., who will serve as bacteriologist. Dr. Russell was graduated from the University of Wisconsin in 1888, holding the fellowship of biology for two subsequent years. In the spring of 1890 he entered the university at Berlin, confining his studies to bacteriology under Prof. Koch. He received the appointment to the American table in the zoölogical station at Naples in the spring of 1891, where he studied the deep sea bacterial flora of the Mediterranean. The same year he studied for a short time in Pasteur's laboratory in Paris. In 1891 he returned to America, entering Johns Hopkins University, where he obtained the degree of PH. D. in bacteriology and vegetable pathology in 1892. The same year he continued a study of marine flora at Wood's Holl, Massachusetts, in the marine biological laboratory. That year he was appointed fellow in bacteriology in the University of Chicago at its opening, acting also as extension lecturer on that subject. Dr. Russell entered upon his work at the station in September and will devote himself almost wholly to the study of the fermentations of milk and its products. By combining his efforts with those of Dr. Babcock the station hopes to contribute materially to the knowledge of dairying. With the coming of Dr. Russell the university offers an advanced course of dairy instruction to those properly fitted for the work. It is probable that several students will avail themselves of this offer during the coming winter term of the dairy school.

In July, 1890, the station gave to the public the first description of the Babcock milk test and how to operate it. Since that time the description with additions has been printed in two additional bulletins and two annual reports, making a total of 60,000 issues containing an account of the test. So great has been the call for information regarding the test that few copies of any of the reports or bulletins now remain in the hands of the station, and the authorities are considering the subject of another bulletin with directions for operating the test. Nothing could better show the interest of the public in this invention than the continued call for bulletins and reports describing it.

A new horticultural building is being erected at the university designed for instruction and investigation. The building will eventually contain the departments of horticulture and agricultural physics, only the entrance and horticultural wing being erected at this time. The present structure covers an area 60 feet in length by 46 in width, being 3 stories in height, with roomy attic. It is constructed of white brick with pink pressed brick and Wauwatosa limestone trimmings. The interior finish is known as mill construction with tile-lined walls, making what is known as a slow burning building. There are offices, library, and microscope room, as well as a large laboratory and a large lecture room. Two greenhouses exte d from the building in the rear, each 22 by 75 feet in area. One greenhouse is provided with benches at which each student will have an assigned space for conducting his studies with plants, cuttings, etc. The other greenhouse is unique in character, being designed for a winter garden. There are no posts or supports of any kind, leaving the whole area without obstruction. This will constitute a garden with rich deep soil, in which the instructors can give the students drill in garden work during winter as though it were summer time. The building is situated on the hillside near the dairy school overlooking the horticultural grounds in front, and Fourth Lake beyond. The building complete will cost $40,000, the present wing with equipment representing an outlay of $24,000.

WYOMING STATION.—The botanist of the station, A. Nelson, has prepared a list of about three hundred duplicate herbarium specimens of Wyoming flora, which will be sent to any one wishing to exchange.

The board of trustees in charge of the University of Wyoming, including the Agricultural College and Experiment Station, is now composed of the following persons: S. W. Downey, Laramie, president; Grace R. Hebard, Cheyenne, secretary; R. H. Homer, Laramie, treasurer; E. Talbot, Laramie; J. D. Loucks, Sheridan; C. L. Vagner, Carbon; A. Kendell, Rock Springs; W. W. Burton, Afton, and A. W. Jones, Casper.

THE DETERMINATION OF PHOSPHORIC ACID.—In *Jour. Amer. Chem. Soc.* (*15, No. 7, pp. 382–395*), H. Pemberton, jr., describes a method based on the titration of the yellow precipitate of ammonium phospho-molybdate, first investigated by him in 1882 (*Jour. Frank. Inst., 113, p. 193; Chem. News, 46, p. 7*). The method as here presented has been used with highly satisfactory results on solutions of pure phosphates, natural phosphates, and fertilizers. "It was seldom that two tests of the same material differed more than 0.1 per cent in P_2O_5 even when the total P_2O_5 present amounted to as much as 40–50 per cent of the substance analyzed.

"The following solutions are used: Ninety grams of crystals [of ammonium molybdate] are dissolved (in a large beaker) in somewhat less than 1 liter of water. This is allowed to settle over night and the clear liquor decanted into a liter flask. The small quantity of insoluble molybdic acid, always present, is dissolved in a little ammonia and added to the main solution. Should the molybdate be found to contain traces of P_2O_5, a few decigrams of magnesium sulphate are added, ammonia being added to faint alkalinity. The whole is then made up to one liter. * * * Each c. c. precipitates 3 mg. of P_2O_5.

"The ammonium nitrate solution is simply a saturated aqueous solution of the salt. * * * Ten c. c. of this solution is amply sufficient for each test.

"The nitric acid used for acidifying the solution of the phosphate has a specific gravity of 1.4 or thereabouts.

"The standard potassium hydroxide solution is of such strength that 1 c. c.=one mg. P_2O_5; 100 c. c. of it will neutralize 32.65 c. c. of normal acid. It can be made from normal potassium hydroxide (that has been freed from all carbonate by barium hydroxide), by diluting 326.5 c. c. to 1 liter. But its strength is best determined empirically by a direct test upon a phosphate solution of known strength, precipitating with ammonium molybdate and making the analysis as described below, all potassium carbonate having first been removed by barium hydroxide.

"The standard acid has the same strength, volume for volume, as the potassium hydroxide and can be made by diluting 326.5 c. c. of normal acid to one liter. In testing it against the alkali, phenolphthalein (and methyl orange) should be used.

"The indicator can be either litmus, rosolic acid, or phenolphthalein. * * *

The method of analysis is as follows: "One gram of phosphate rock, or 2 or 3 grams of fertilizer are dissolved in nitric acid, and without evaporating to dryness diluted to 250 c. c. The solution need not be filtered. Twenty-five cubic centimeters of the solution are delivered into a 4-ounce beaker and neutralized with ammonia until a precipitate just begins to form, and then treated with 5 c. c. of HNO_3 of 1. 4 specific gravity. Ten cubic centimeters of a saturated solution of ammonium nitrate are added and the solution diluted to a volume of 50 to 75 c. c. It is then brought to a full boil, removed from the lamp and 5 c. c. of the aqueous solution of ammonium molybdate added. This is followed by a second and a third 5 c. c., if necessary, the precipitate allowed to settle, and filtered at once through a 7 cm. diameter filter. It is washed thoroughly with water by decantation and on the filter. The filter and precipitate are transferred bodily to the beaker. Standard alkali is then run in and at least 0.5 c. c. of phenolphthalein (1 per cent solution) added, and then standard acid, until the color vanishes. Each centimeter of alkali equals 1 mg. of phosphorus pentoxide."

The calculation of the percentage of phosphoric acid is based upon the fact, demonstrated by experiment, that 23 molecules of Na^2CO_3 are required for each molecule of phosphoric acid in the ammonium phospho-molybdate as shown by the following formula:

$$6\ NH_4P^2O_8.\ 24\ MoO_3+23\ Na^2Co_3+H^2O=(NH_4)_4.\ H^2P^2O_8+(NH_4)^2\ MoO_4+23\ Na_2\ MoO^4+23\ CO_2$$

REPORT OF THE IOWA WEATHER AND CROP SERVICE FOR THE YEAR 1892.—This report presents summaries of observations at 46 meteorological stations, and of reports of 76 weather-crop observers in the State, under the following heads: The meteorological conditions for each month of the year, monthly crop reports, and weather-crop bulletins. The meteorological data and crop conditions are given in 2 charts and numerous tables.

"Twenty-five weekly weather-crop bulletins were issued during the crop season, the total number of copies distributed being about 35,000. Summaries of these bulletins, giving the status and prospect of crops from week to week, were copied by the weekly and daily press, and were circulated by the Associated Press and special dispatches.

"The total number of copies of the Monthly Review distributed during the year was about 22,000, answering the constantly increasing requests for this publication.

"About the first of June the first regular monthly crop report was tabulated from the estimates of the 1,000 crop correspondents of this Bureau, showing the acreage and condition of the staple crops. Reports were also issued in July, August, October, and December, and widely disseminated through the Monthly Review, the press, and other channels of communication to the public.

"Through the agency of the State service the daily weather forecasts of the National Bureau were widely disseminated to meet the increasing public demand, and the number of display stations has been materially increased. A very considerable percentage of the people are now receiving the benefits of the daily weather forecasts.

"The mean temperature of the year 1892, for the State, was 47.5°, which is about the average for the past 20 years. The mean of 1890 was 47.7°, and in 1891 it was 47.4°, showing a notable adherence to the general average in years widely different in those features of the weather affecting the crop production.

"The winter months of 1892 were generally mild, with about the usual number of stormy days, and above the average amount of precipitation. The spring months were abnormally cold, wet, and backward, with an unusual number of stormy days and excessive cloudiness. * * *

"The average total precipitation (rain and melted snow) was 35.74 inches. The greatest amount reported was 48.77 inches at Dubuque; least amount, 24.78 inches at Sac City. The average snowfall was 31.7 inches; highest total reported, 50 inches at Richland; least amount, 8 inches, at Glenwood. Over two thirds of the average precipitation of the year fell in the six crop months—April 1 to October 1."

ANALYSES OF SOILS OF THE CAPE OF GOOD HOPE.—The *Report of the Senior Analyst of the Cape of Good Hope for 1892* gives analyses of soils from fourteen localities in the colony. At least in a part of the colony the soil is remarkably poor in phosphates and the author recommends the use of phosphatic fertilizers. It is stated that a systematic investigation of soils will soon be undertaken. Twenty analyses of wines, three of sheep dips, and one of sugar cane are among the analyses reported. A brief summary of the results of an experiment to determine the action of insecticide solutions upon the rubber of spraying pumps is given.

THE DEVELOPMENT AND EXTENT OF THE FERTILIZER INDUSTRY.—Under this title Dr. C. U. Shepard gives in *Jour. Amer. Chem. Soc.* (*15, No. 6, pp. 321–343*) a review of the history of the fertilizer industry, from the time when the value of phosphatic substances as manure was first recognized and superphosphates began to be manufactured, up to the present time. This review is accompanied by extensive statistical data relating to the development of the phosphate industry in different parts of the world, the sources and supply of guanos, nitrate of soda, sulphate of ammonia, the Stassfurt potash salts, nitrate of potash, and Thomas slag and other mineral phosphates, and the extent of the use of fertilizers in the United States and other countries.

"The consumption of commercial manures in the United States has grown very rapidly during the past twenty years in the Atlantic and especially the South Atlantic States. Their use is steadily on the increase in the Central and Gulf States. Gradually they are being sought after in the less distant and more thickly populated of the Western ones."

The consumption in different States is stated to be as follows:

	Tons.
Vermont	4,000
Maine, New Hampshire, Massachusetts, and Rhode Island	40,000
Connecticut	20,000
New York	92,000
New Jersey (estimated)	60,000
Pennsylvania	150,000
Delaware and Maryland (estimated)	75,000
Virginia	140,000
West Virginia	15,000
North Carolina	145,000
South Carolina	200,000
Georgia	280,000
Florida	40,000
Alabama	90,000
Mississippi	25,000
Louisiana	15,000
Ohio	50,000
Indiana	35,000
Kentucky	12,000
Tennessee	15,000
Other States (estimated)	47,000
Total	1,550,000

The world's consumption of commercial manures may be estimated at the following figures:

			Tons.
The United States			1,550,000
Germany			1,300,000
France			1,000,000
Great Britain			1,000,000
Belgium, Holland	300,000		
Scandinavia	100,000	}	650,000
Spain, Italy, and Austria	250,000		
Total			5,500,000

FERTILIZER INSPECTION IN MISSISSIPPI.—In Bulletin No. 2 of the Mississippi Agricultural College, W. L. Hutchinson, State chemist, gives notes on valuation of fertilizers and tabulates and discusses the results of analyses of 173 fertilizers offered for sale in the State during the season of 1892–'93.

EXPERIMENTS AT ROTHAMSTED EXPERIMENTAL STATION DURING FIFTY YEARS.—The annual memoranda for 1893 on the origin, scope, and plan of the Rothamsted experiments gives the history of the station and tabulated summaries of the experiments, together with a detailed list of the published articles. The statements are made in the same form as heretofore, but are corrected up to date. A general account of the work at Rothamsted based on the memoranda for 1891 was published in the Experiment Station Record, vol. III, p. 73.

"The rainfall has been measured at Rothamsted, in gauges of different sizes, almost from the commencement of the field experiments ; and the drainage through 20 inches, 40 inches, and 60 inches of unmanured and uncropped soil, in its natural state of consolidation, has been collected from September, 1870, up to the present time, a period of nearly twenty-three years. * * * The loss of nitric acid is obviously very directly dependent on the amount and on the distribution of the rain and of the drainage. Indeed, although there seems to be some indication of a decline in the amount of nitric acid formed over the later as compared with the earlier years, the evidence is certainly not yet very conclusive. It is estimated that during the twenty-two harvest years ending August, 1892, there has been a loss of nitrogen through the 20-inch gauge of rather more than 11, through the 40-inch of about 6, and through the 60-inch gauge of little more than 5 per cent of the total combined nitrogen in the soil and subsoil."

Experiments with wheat alternated with fallow *vs.* wheat grown continuously for fifty years have shown "that although there is an increase of produce after fallow compared with that of wheat grown continuously, it is obtained at the sacrifice of a crop every other year ; and that *a given area of land* yields more when the crop is grown year after year than when alternated with fallow. The explanation doubtless is that much of the nitrogen, brought into an available condition under the influence of the fallow, is lost by drainage during the long period that the land is without a crop."

Experiments with leguminous plants (peas, beans, red clover, etc.) during a number of years, in which various fertilizers have been used, indicated that the minerals, especially potash, considerably increased the crops during the earlier years after their application, but that "ammonium salts had little or no beneficial effect and were sometimes injurious." Experiments with red clover on ordinary and garden soils gave results described as follows:

"The general result of the experiments on ordinary arable land in the field has been—that neither organic matter rich in carbon as well as other constituents, nor ammonium salts, nor nitrate of soda, nor mineral constituents, nor a complex mixture,

supplied as manure, availed to restore the clover-yielding capabilities of the land; though where some of these were applied in large quantity and at considerable depths the result was better than when they were used in only moderate quantities and applied only on the surface.

"On the other hand, it is clear that the soil in the garden, which at the commencement contained in its upper layers about four times as much nitrogen as the arable land, and would doubtless be correspondingly rich in other constituents, has supplied the conditions under which clover can be grown year after year on the same land for many years in succession.

"The results obtained on the soil in the garden seem to show that what is called "clover-sickness" can not be due to the injurious influence of excreted matters upon the immediately succeeding crop.

"That clover frequently fails coincidently with injury from parasitic plants, or insects, can not be disputed; but it may be doubted whether such injury should be reckoned as the cause, or merely the concomitant, and an aggravation, of the failing condition.

"The results of the experiments seem, therefore, to exclude the supposition that the *primary* cause of failure is either destruction by parasitic plants or insects, injury from excreted matters, or the shade of a corn crop, and to indicate that it must be looked for in exhaustion of some kind within the range of the roots. * * * It is a fact of much significance that over a period of twenty-one years the diminution in the amount of nitrogen in the garden soil to the depth of 9 inches only represented approximately two thirds as much as was estimated to have been taken out in the crops; and it was concluded that there had been considerable reduction in the lower depths also. * * * Recent experiments at Rothamsted have confirmed those of others in showing that, by adding to a sterilized sandy soil growing leguminous plants a small quantity of the watery extract of a soil containing the appropriate organisms, a marked development of the so-called leguminous nodules on the roots is induced; and that there is, coincidently, increased growth and gain of nitrogen. There is no evidence that the leguminous plant itself assimilates free nitrogen; the supposition is rather that the gain is due to the fixation of nitrogen in the growth of the lower organisms in the root nodules, the nitrogenous compounds so produced being taken up and utilized by the leguminous plant."

INDIA.—The Annual Report of Khandesh experimental farm for the year ending March 31, 1893, contains accounts of experiments with wheat, cotton, potatoes, cattle, goats, and sheep. "Experiments to test the stability of color and consistency in wheat have been in progress for some years, and it has been fully proved that in ordinary seasons, and under ordinary cultivation, a variety of wheat of one locality maintains its natural characteristics if grown in another, even though the conditions of soil and climate are different."

The experiments carried on in different parts of Assam during the same year were with rice, sugar cane, mustard, and miscellaneous crops.

EXPERIMENTS WITH FIELD CROPS IN BENGAL.—The Annual Report of the Department of Land Records and Agriculture, Bengal, for the year ending March, 1892, gives the results of experiments made on several farms with sugar cane, jute, rice, maize, cotton, potatoes, wheat, oats, and barley. When the top of the maize plant was cut off before the cob was quite mature the yield of grain was less than when the top was left intact. Experiments with Nankin and with an American variety of cotton resulted in a larger yield by the former. Hemp was used as a green manure for potatoes and the yield was more than double that on an adjoining unfertilized plat. When bone meal was added to hemp used as a green manure the yield was still further increased.

LATHYRUS SYLVESTRIS.—The *Agricultural Students' Gazette, Cirencester, England* (*6, No. 4, pp. 108, 109*), gives a note on eleven species of the genus *Lathyrus* recorded as British; also, analysis of *Lathyrus sylvestris* and a note on its growth in the exceptionally

dry season of 1893. "A plat was sown in the botanic garden in 1890. * * * The plant has taken some time to establish itself, more than a year passing before a cutting was obtained, but then it takes strong hold and grows vigorously. It is not injured by very severe weather in winter. * * * This year the plat in the botanic garden was cut on May 30, and yielded at least 3,000 pounds of hay per acre. A second crop is now (August 4) ready. The hay was readily eaten by cows. The *Lathyrus* and lucern were the only plats which gave any large yield in this season of exceptional drought."

The following extract is from the reports of the agricultural assistants of the Cape of Good Hope for 1892: "*Lathyrus sylvestris* may be cut twice a year, and thus yields less green food than lucern. * * * It withstands drought very well. This plant looked nice and green when the other plants looked rather faded. * * * Our experience in the garden is that it germinates slowly.

PEDIGREE OR GRADE RACES IN HORTICULTURE.—A paper by H. L. Vilmorin, entitled "Pedigree or Grade Races in Horticulture," was read before the Seedsmen's Session of the World's Fair Horticultural Congress and published in *Gard. Chron. (ser. III, 14 (1893), pp. 301, 332–333)*. In this paper the author reports a hitherto unpublished experiment in cultivating and modifying by selection of seed a European weed of the parsley family (*Anthriscus sylvestris*). In the first ten years, during each of which seed was selected, the change from the slender and much-forked roots of the wild plant into fleshy, straight, and clean roots was slight. In the ten years following, these changes toward the type desired were more and more marked with each generation.

From experiments conducted by the author's father on *Lupinus hirsutus*, the author draws the following conclusions:

"(1) The tendency to resemble its parents is generally the strongest in any plant.

"(2) But it is notably impaired if coming into conflict with the tendency to resemble the bulk of the ancestors.

"(3) This latter tendency (called atavism) is constant, though not very strong, and scarcely becomes impaired by a series of generations passing by without a reversion to the ancestral type having taken place.

"(4) On the contrary, the tendency to resemble a near progenitor (two or three generations only distant) very soon becomes obliterated, if the said progenitor be different from the bulk of the ancestors. From this it will be seen that choice new races can be raised quickest, and with the smallest amount of labor, where all needless conflict in the hereditary powers is avoided."

Where several plants with the desired quality are selected as seed producers, he advises sowing the seed of each plant separately, as one of these plants may be much stronger than the rest in transmitting its qualities. This prepotency is, in the author's opinion, just as hereditary as any other quality.

Contrary to a common belief, the author found that the portion of the stem from which pods of German stock were taken exercised no influence on the proportion of double flowers on the plants grown from such seed. Experiments on German stocks, verbenas, and chrysanthemums indicated no difference among the progeny of seed taken from different parts of the same plant, though the descendants of different plants of the same variety showed important differences.

MASSACHUSETTS HORTICULTURAL SOCIETY.—The transactions of this Society for 1892 contain a descriptive list of the publications on horticulture and other subjects added to the library of the Society during the year.

FUNGI IN WINE-MAKING.—Mr. Arthur P. Hayne, writing to *The Pacific Rural Press*, states that while investigating the fungi which cause various kinds of rot in the grapes of California, he found one which may prove a genuine advantage. "This is *Botrytis cinerea*, which is essential to the production of the very best Château Yquem Saûterne as well as the Rhine wines of Johannisberg. Grapes which are covered with this mold, and are seemingly rotten, are sold for as much as $1,000 a

ton. The fungus is not altogether a blessing, for when it attacks black or red grapes it robs them of their color and destroys the tannin which is necessary to make clarets. Besides this, it concentrates the sugar until it becomes impossible to make a dry wine. It is only on white grapes that it is beneficial, and it must be carefully studied and experimented with in California before its true character there can be discovered. In wet cold years it may develop before the grape is ripe and cause it to rot before it matures, or it may develop to such an extent on the stem as to cause the loss of the entire bunch. But when it appears late on a white variety it merely decomposes the skin of the berry, allowing the oxygen of the air to act slowly on the juice and produce certain complex acids which are essential to those peculiar flavors found only in the best vintages of the white wine region in Europe."

METHOD FOR DETECTING BUTTER ADULTERATION.—M. Brullé, director of the agricultural institute at Paris, it is claimed, has discovered a method by which the adulteration of butter with as low as 5 per cent of foreign fat can be safely and surely detected by any person in a few minutes. No previous knowledge of chemistry or costly apparatus is required. M. Brullé has demonstrated the effectiveness of his method or test to a committee of the Prenzlau Creamery Association in Germany, and the association has purchased the exclusive right of the invention for Germany. Great claims are being made for the invention by German dairy papers which assert that it will be the means of stamping out the adulteration of natural butter with margarin, etc., which has been such a constant menace to the dairy interests of that country. Dr. Wollny, of Kiel, has been invited to submit the method to a thorough test.

A TRIAL OF SHEEP-SHEARING MACHINES.—The *Journal of the Royal Agricultural Society of England* (*4, No. 15, pp. 547–552*), gives an account of trials made at Chester, June 17, 1893, with three sheep-shearing machines. All three were operated by power. It was the opinion of the judges that shearing by machinery could be economical only where large numbers of sheep are to be sheared and where the power may be used to run several machines.

One of the machines tested weighed 3 pounds 10 ounces: another, 4 pounds 2 ounces. The prize was awarded to the Burgon & Ball (Sheffield) machine. The time required to shear ten sheep was one hour, seven minutes, and fourteen seconds. The quality of the work done by this machine was excellent; "there was but little wounding of the sheep, the cutting was uniformly close, and there was little waste of wool."

RECENT ARTICLES BY STATION WORKERS.—Station workers have contributed to current publications as follows: *Torrey Bulletin* (*vol. XX*): Notes on *Carex*, L. H. Bailey, pp. 417–429; Extent of the annulus and the function of the different parts of the sporangium of ferns in the dispersion of spores, G. F. Atkinson, pp. 435–437; Notes on a new *Exobasidium*, B. D. Halsted, pp. 437–440; Notes on *Cicuta maculata*, L. H. Pammel, pp. 441, 442.

Garden and Forest (*vol. VI*): Is the woodpecker useful? J. B. Smith, p. 483; Diseases of raspberries and blackberries, F. W. Card, p. 486; The rust of mountain ash, B. D. Halsted, p. 508.

PERSONAL MENTION.—The curator of the Liebig fund of the Royal Bavarian Academy of Science at Munich has conferred the Liebig silver medal on Prof. E. W. Hilgard, of California, in recognition of his valuable investigations on the physical and chemical properties of soils, and on Sir John Bennet Lawes and Sir Henry Gilbert, of Rothamsted, in appreciation of their valuable services to agriculture in general.

Dr. P. Sorauer, of Proskau, resigned his position at the head of the physiological experiment station at that place October 1. He will be succeeded by Dr. R. Aderhold.

Dr. A. Terracciano has retired as curator of the Royal Botanic Institute at Rome. His successor is Dr. Oswald Kruch.

LIST OF PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE.

NOVEMBER, 1893.

Preliminary Report of the Secretary of Agriculture for 1893.

DIVISION OF BOTANY:

Contributions from the U. S. National Herbarium, vol. IV.

WEATHER BUREAU:

Monthly Weather Review, September, 1893.

DIVISION OF ENTOMOLOGY:

Insect Life, vol. VI, No. 1, November, 1893.

BUREAU OF ANIMAL INDUSTRY:

Bulletin No. 3.—Miscellaneous Investigations concerning Infectious and Parasitic Diseases of Domesticated Animals.

DIVISION OF STATISTICS:

Report No. 110 (new series), November, 1893.

LIST OF STATION PUBLICATIONS RECEIVED BY THE OFFICE OF EXPERIMENT STATIONS

NOVEMBER, 1893.

AGRICULTURAL EXPERIMENT STATION OF THE AGRICULTURAL AND MECHANICAL COLLEGE OF ALABAMA:

Fifth Annual Report, 1892.

STORRS SCHOOL AGRICULTURAL EXPERIMENT STATION:

Fifth Annual Report, 1892.

AGRICULTURAL EXPERIMENT STATION OF THE UNIVERSITY OF IDAHO:

Bulletin No. 4, July, 1893.—Methods of Preventing Smut in Wheat and Oats; Carbon Bisulphide as a Squirrel Exterminator; A New Squirrel Exterminator.

KANSAS AGRICULTURAL EXPERIMENT STATION:

Fifth Annual Report, 1892.

Bulletin No. 37, December, 1892.—Experiments in Potato Culture.

Bulletin No. 38, March, 1893.—Preliminary Report on Rusts of Grain.

Bulletin No. 39, August, 1893.—Experiments in Feeding Steers.

Bulletin No. 40, August, 1893.—Experiments in Wheat.

LOUISIANA AGRICULTURAL EXPERIMENT STATIONS:

Fifth Annual Report, 1892.

MASSACHUSETTS STATE AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 50, October, 1893.—Meteorological Summary, August and September, 1892-'93.

Analyses of Commercial Fertilizers collected during 1893

HATCH EXPERIMENT STATION OF THE MASSACHUSETTS AGRICULTURAL COLLEGE:
Meteorological Bulletin No. 58, October, 1893.

EXPERIMENT STATION OF MICHIGAN AGRICULTURAL COLLEGE:
Fifth Annual Report, 1892.

NEW JERSEY AGRICULTURAL EXPERIMENT STATIONS:
Thirteenth Annual Report of the State Station, 1892; Fifth Annual Report of the College Station, 1892.
Bulletin No. 96, October, 1893.—Cornstalks and Straw as Hay Substitutes.

NEW YORK AGRICULTURAL EXPERIMENT STATION:
Bulletin No. 59 (new series), September, 1893.—Analyses of Commercial Fertilizers collected in the Spring of 1893.

CORNELL UNIVERSITY AGRICULTURAL EXPERIMENT STATION:
Bulletin No. 58, October, 1893.—The Four-lined Leaf-bug.
Bulletin No. 59, November, 1893.—Does Mulching Retard the Maturity of Fruits?

NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION:
Bulletin No. 92, August 22, 1893.—The Culture of Orchard and Garden Fruits.
Bulletin No. 93*a*, October 15, 1893.—Meteorological Summary, September, 1893.

NORTH DAKOTA AGRICULTURAL EXPERIMENT STATION:
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OKLAHOMA AGRICULTURAL EXPERIMENT STATION:
Press Bulletin No. 8, November, 1893.

AGRICULTURAL EXPERIMENT STATION OF UTAH:
Bulletin No. 24, August, 1893.—Irrigation.

VIRGINIA AGRICULTURAL AND MECHANICAL COLLEGE EXPERIMENT STATION:
Bulletin No. 26, March, 1893.—Tuberculosis and the Koch Test.
Bulletin No. 27, April, 1893.—Strawberries.
Bulletin No. 28, May, 1893.—Tests of Varieties of Wheat.
Bulletin No. 29, June, 1893.—Tests of Fertilizers on Wheat.

WYOMING AGRICULTURAL EXPERIMENT STATION:
Bulletin No. 14, October, 1893.—Geology of the Wyoming Experiment Farms, and Notes on the Mineral Resources of the State.

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The following publications have been issued:

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Bulletins.—No. 1, Organization and History of the Stations; No. 2, Digest of Annual Reports of the Stations for 1888, in two parts; No. 3, Report of Meeting of Horticulturists at Columbus, Ohio, June, 1889; No. 4, List of Station Horticulturists and Outline of their Work; No. 5, Organization Lists of Stations and Colleges, March, 1890; No. 6, List of Station Botanists and Outline of their Work; No. 7, Proceedings of the Fifth Annual Convention of the Association of American Agricultural Colleges and Experiment Stations, Washington, D. C., August, 1891; No. 8, Lectures on Investigations at Rothamsted Experimental Station; No. 9, The Fermentations of Milk; No. 10, Meteorological Work for Agricultural Institutions; No. 11, A Compilation of Analyses of American Feeding Stuffs; No. 12, Organization Lists of the Agricultural Experiment Stations and Agricultural Schools and Colleges in the United States, June, 1892; No. 13, Organization Lists of the Agricultural Experiment Stations and Agricultural Schools and Colleges in the United States, April, 1893; No. 14, Proceedings of a Convention of the National League for Good Roads, January, 1893; No. 15, Handbook of Experiment Station Work; No. 16, Proceedings of the Sixth Annual Convention of the Association of American Agricultural Colleges and Experiment Stations, New Orleans, Louisiana, November, 1892; No. 17, Suggestions for the Establishment of Food Laboratories.

Miscellaneous Bulletins.—No. 1, Proceedings of Knoxville Convention of Association of Agricultural Colleges and Stations, January, 1889; No. 2, Proceedings of Washington Convention of the Association, November, 1889; No. 3, Proceedings of Champaign Convention of the Association, November, 1890.

Farmers' Bulletins.—No. 1, The What and Why of Agricultural Experiment Stations; No. 2, Illustrations of the Work of the Stations; No. 9, Milk Fermentations and their Relation to Dairying; No. 11, The Rape Plant.

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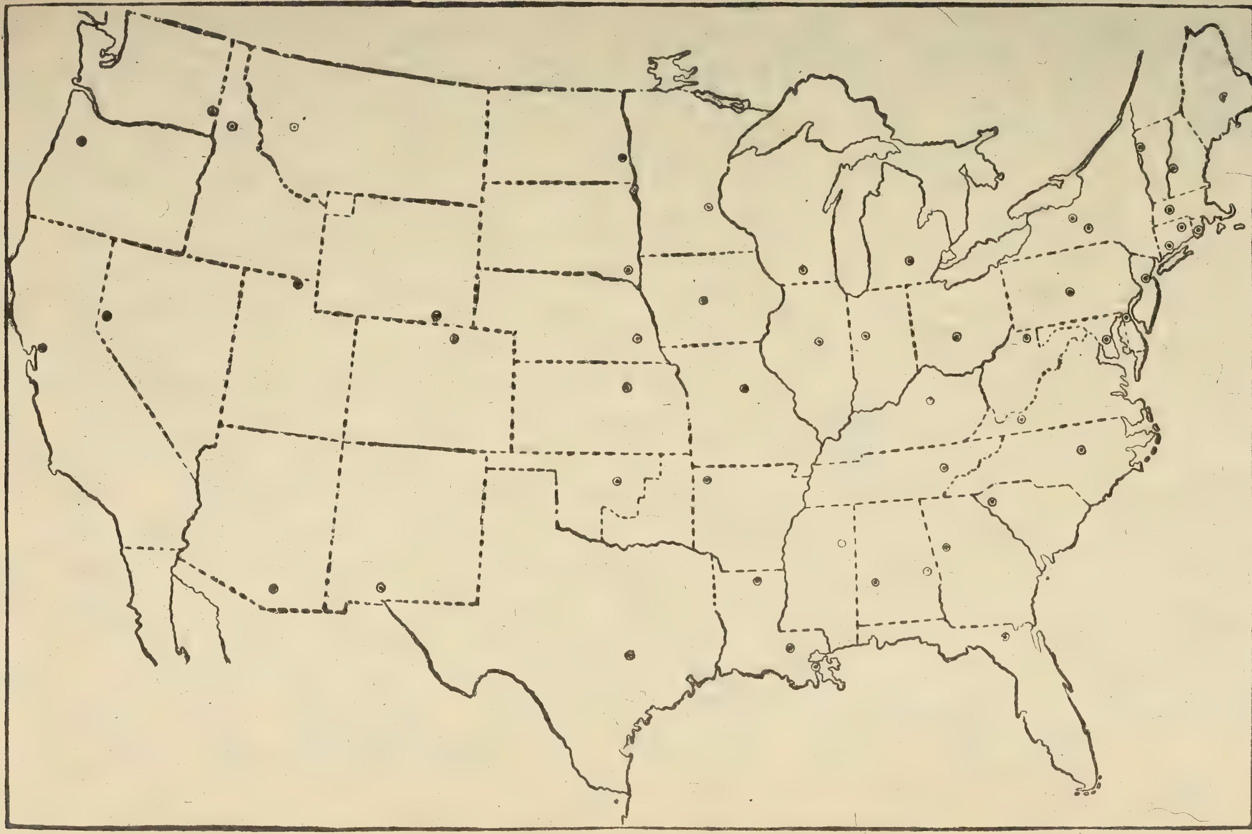

The Agricultural Experiment Stations in the United States.

U. S. DEPARTMENT OF AGRICULTURE

OFFICE OF EXPERIMENT STATIONS

Vol. V No. 5

EXPERIMENT STATION

RECORD

PUBLISHED BY AUTHORITY OF THE SECRETARY OF AGRICULTURE

WASHINGTON
GOVERNMENT PRINTING OFFICE
1894

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U. S. DEPARTMENT OF AGRICULTURE

OFFICE OF EXPERIMENT STATIONS

Vol. V No. 5

EXPERIMENT STATION RECORD

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EXPERIMENT STATION RECORD.

Vol. V. No. 5.

The annual meeting of the American Chemical Society, held at Baltimore December 27 and 28, 1893, attracted about sixty-five chemists. The sessions were held in the chemical lecture room of Johns Hopkins University, and President D. C. Gilman and Prof. Ira Remsen, of the university, made addresses of welcome. Some twenty papers were read either in full or by title; and during the afternoons interesting excursions were made to the works of the Baltimore Copper Smelting and Rolling Company and the Maryland Steel Company. A complimentary banquet was given the chemists the evening of the first day.

In a paper entitled The waste and conservation of plant food, Dr. H. W. Wiley, the president of the society, pointed out some of the ways in which the supply of fertilizing ingredients in the soil is depleted and dissipated, and some of the indirect ways in which these ingredients are and may be returned to the soil. In considering the losses of plant nutrients he confined himself to those incidental to the cultivation of the soil, rather than those which normally take place in the production of a crop. He mentioned the frequent losses from the denudation of cultivated fields by water, and referred to the beneficial effects of lime in diminishing these losses, especially on stiff clay soils. Great, however, as is this mechanical loss, it is by no means as dangerous as the loss of soluble materials by the percolation of the water through the soil. This loss is considerably influenced, among other things, by cropping and by the character of the crop. The immense quantities of fertilizing materials thus removed from the soil and carried away to the seas are apparently lost to agriculture forever. But he explained that the loss is not real, for nature has provided means by which the materials may be gradually returned to the soil. This return is effected through the application of seaweed, fish fertilizer, phosphatic deposits, guano, nitrate of soda, and potash salts, and through the rainfall and the collection or assimilation of nitrogen from the atmosphere by plants and lower organisms. The fact that a few million years may supervene before the particle that is carried off to-day as waste may return to organic life shows the patience rather than the wastefulness of nature. Hence the reassuring conclusion is reached that "there is no danger

whatever of the ultimate consumption or waste of the materials on which plants live. Circumscribed localities, through carelessness or ignorance, where once luxurious crops grew may become sterile, but the great source of supply is not exhausted."

Prof. F. W. Clarke read an interesting report on the determinations of atomic weights published during 1893.

A paper on the utilization of garbage, by Bruno Terne, was read only by title, on account of the absence of the author.

In a paper on salicylic acid in food, K. P. McElroy discussed a number of methods for detecting salicylic acid in food, and concluded that the reaction with a one half per cent solution of iron chloride was the most satisfactory.

The importance of the study of biochemistry was the subject of a suggestive paper by Dr. E. A. de Schweinitz. He explained the modern theory of contagious diseases, *i. e.*, the poisoning of the system with the products of bacterial life, and called attention to the meager state of our knowledge of these products and, in fact, of the theory of the whole subject. "A guinea pig may be protected from a hog cholera inoculation by an injection of the albuminoid product extracted from the cultures. The same pig will die if inoculated with swine plague. If, however, it is vaccinated both for hog cholera and swine plague, with the products extracted from their respective cultures, the animal will be insusceptible to both diseases. Just in the same way in each particular disease some chemical change is produced in the blood or tissues, and the work of the chemist should be to find out what these changes are."

Among other profitable fields of work for the biochemist he mentioned studies of tobacco fermentations, as a means for improving the quality of certain tobaccos; the problems of nitrification, and of nitrogen assimilation by plants, as well as the assimilation of mineral matters by plants; and bacteria in their relations to dairying. The flavor and aroma of butter and cheese are due to products of the growth of particular bacteria. A study of these products would, he believed, show them in many instances to be substances of easy synthetical preparation. It would be far better, he suggested, to be able to add to a butter or cheese some particular extract which would impart the special flavor or quality desired than to inoculate the milk and cheese with particular bacteria to produce that quality.

It is along this line of biochemical research, he predicted, that the solution of many of the problems of life which have puzzled both physiologists and chemists is to come.

Dr. Thomas Taylor spoke briefly on the employment of the silver nitrate test for detecting adulterations of olive oil and lubricating oils.

T. M. Chatard described a rather simple scheme of arranging chemical abstracts and clippings for preservation. The decimal system was used, and an effort had been made to make the key as simple as possible.

At present the scheme covers inorganic, industrial, and applied chemistry, but does not include theoretical organic chemistry.

W. D. Noyes described the detection of strychnine in an exhumed human body three hundred and five days after burial; and O. Carr read a paper on the distribution of the oleoresins in *Pinus palustris*. Most of the other papers related to mineralogical or metallurgical chemistry.

H. W. Wiley, president, and A. C. Hale, secretary, were reëlected. The society is to make application to Congress for a charter. Committees were appointed to decide upon a system of abbreviations, chemical nomenclature, and the general style of the journal of the society; and to consider the question of the free importation of apparatus and supplies for chemical research, as well as for use in instruction, and a more liberal interpretation of the act now in force on the part of customs officers.

Elsewhere in this number of the Record a description is given of the methods of chemical analysis employed at the agricultural experiment station at Halle, Germany. This description, like the preceding one of the buildings, outfit, and general work of the Halle station, has been condensed from an illustrated account of the station prepared at the suggestion of this Office by Dr. K. Bieler and Dr. W. Schneidewind, two assistants in the station.* The methods described are largely those recommended by the Association of German Experiment Stations, although there are certain modifications in the interest of accuracy or rapidity which have been made as a result of experience at the station.

The analytical work at the Halle station is so extensive that great effort has been made to thoroughly systematize it and to economize time without impairing accuracy. During the busy season the work is divided among the force, different parts of a given determination being assigned to different analysts. In this way, and by simplifying to the last degree the methods used, the maximum number of determinations is accomplished. The fact that seventy-two determinations of nitrogen, one hundred determinations of phosphoric acid, and a large number of determinations of crude fiber are made in a single day, is an indication of the success of the system worked out.

Some of the methods or apparatus described in the article are peculiar to the Halle station, and these are described in detail and usually illustrated. Among these are the methods for crude fiber, for detecting adulteration of Thomas slag, and for carrying out the details of the phosphoric acid determination on an extensive scale. Others, like the Kjeldahl method for nitrogen, the determination of albuminoid nitrogen and of fat in feeding stuffs, etc., are so well known that only brief mention is made of any unusual features. Others again, although they are practically the same as used elsewhere, have not been widely

*Die agrikultur-chemische Versuchsstation Halle a. S., ihre Einrichtung und Thätigkeit, pp. 147, figs. 27, Berlin: Paul Parey.

described in this country or are not readily accessible to English readers. Among these may be mentioned the citrate method for phosphoric acid, determination of free fatty acids and iodine number for fat of feeding stuffs, methods for nitric nitrogen, detection of ground horn in ground bone, and the examination of soap.

The article contains much that is suggestive, and it brings together in condensed form the methods used by many of the German stations in common and by the Halle station in particular.

APPARATUS AND METHODS OF ANALYSIS EMPLOYED AT THE AGRICULTURAL EXPERIMENT STATION AT HALLE, GERMANY.

In a previous paper* a description was given of the agricultural experiment station at Halle, Germany, its history, outfit, lines of work, and methods of investigation. The present article includes a more or less detailed description of the methods of chemical analysis and the apparatus used in the chemical laboratories of that station. In general the methods of analysis adopted by the Association of German Experiment stations are employed at the Halle station; but here, as in other laboratories, there are special features in the apparatus used and in the carrying out of details by the standard methods peculiar to that station. The laboratory work is so extensive and so much study and thought have been given to reducing the element of time that the routine of work is believed to be of more than ordinary interest to chemists. The following descriptions will serve the double purpose of calling attention to some of the German methods, which differ more or less from those of our Association of Official Agricultural Chemists, and explaining some of the peculiar features which are the outgrowth of extended experience in Halle.

SAMPLING AND PREPARATION OF MATERIALS FOR ANALYSIS.

In sampling fertilizers the whole sample is mixed by hand on paper. If the amount† is 600 grams or more, 300 grams, if less, one-half, and if only 100 grams, the whole is taken for analysis. The unused portion is preserved in a cool room for three months after the report of the analysis is sent. Superphosphates, ground bone, and the like are ground to pass a 1 mm. sieve; other materials, as Thomas slag, dried blood, ground fish, etc., are ground to pass a one half mm. sieve. Apatite is dried twelve hours at 100° C., weighed, ground, passed through a 4 mm. sieve, mixed, and an average sample ground to pass through a one half mm. sieve. Wool waste and other materials not easily sampled are evaporated with hydrochloric acid, mixed with gypsum, weighed, and then pulverized.

Feeding stuffs are ground to pass a 1 mm. sieve or finer. Wet materials, as distillery slop, diffusion residue, etc., are dried, with the addi-

* E. S. R., vol. v, p. 363.

† The German Association recommends that the sample contain not less than 250 to 500 grams, and that it be shipped and kept in a tight glass bottle.

tion of 10 grams of magnesia per kilo when necessary to prevent loss of volatile acids, before grinding.

The grinding of samples is done by servants with the aid of a gas or water motor. For ordinary grinding the Excelsior mill has given the best satisfaction. For reducing coarsely ground substances to the finest powder the mill devised by Prof. Maercker, and made at Dreefs, in Halle, is used. The essential features of the Maercker-Dreefs mill are a flat-bottomed mortar of 15 cm. internal diameter, and a flat-bottomed pestle 8 cm. in diameter, both of hard steel, the bottoms of which are cut like a file. The mortar and pestle revolve eccentrically and in opposite directions in such a way that the bottom of the pestle plays over the whole surface of the mortar with each revolution of the latter. The material is thus brought between the two file-like surfaces and cut and ground to extreme fineness. The pestle is raised by a lever. It is made heavier or lighter, according to the nature of the substance to be ground, by changing the weights above it. A cover is placed over the mortar to prevent the fine particles from escaping while the material is being ground. The mill can be operated by hand or motor power.

DETERMINATION OF WATER AND ASH.

Moisture is ordinarily determined in feeding stuffs by drying at 100° C. in a large steam drying oven. For the most exact work (especially

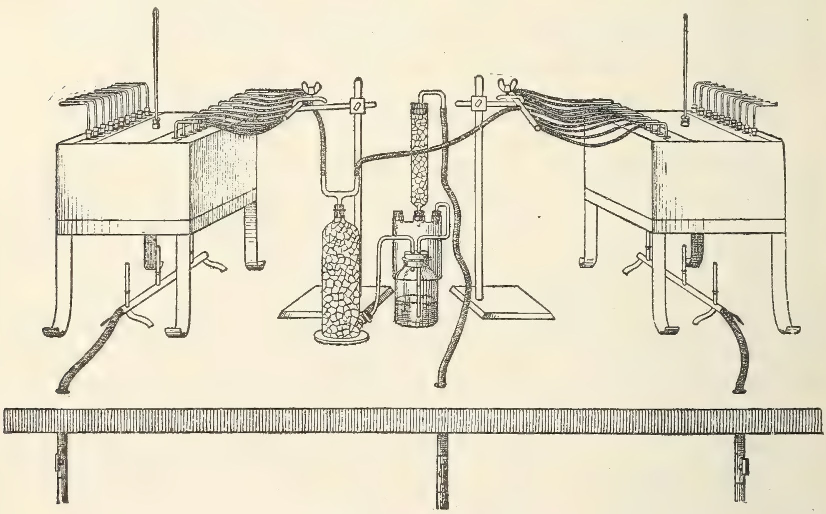

FIG. 3.—Baths for drying in hydrogen.

for fat extraction) the drying is done in a current of illuminating gas, which has been found to replace hydrogen very satisfactorily for this purpose. The material is held in Liebig drying tubes, and these are placed in a paraffin bath heated to 105° to 107° C. Two such baths, each holding ten tubes, are used as shown in the accompanying figure (Fig. 3).

The drying is ordinarily continued from eight to ten hours. Five grams of air-dry feeding stuffs is commonly used for the water determination. In the case of coarse fodders a tube full is taken. Ten grams of fertilizer is dried for about three hours in air at 105° to 110° C.

Ash is determined in the ordinary manner.

DETERMINATION OF CRUDE FIBER.

Crude fiber is estimated by extracting the substance, usually 3 grams, with dilute acid and alkali, by the usual so-called Weende method. The operation is conducted in pear-shaped bulbs of about 300 c. c. capacity devised by Dr. Holdefleiss.* The apparatus for making six determinations simultaneously is shown in Fig. 4. A filter of glass

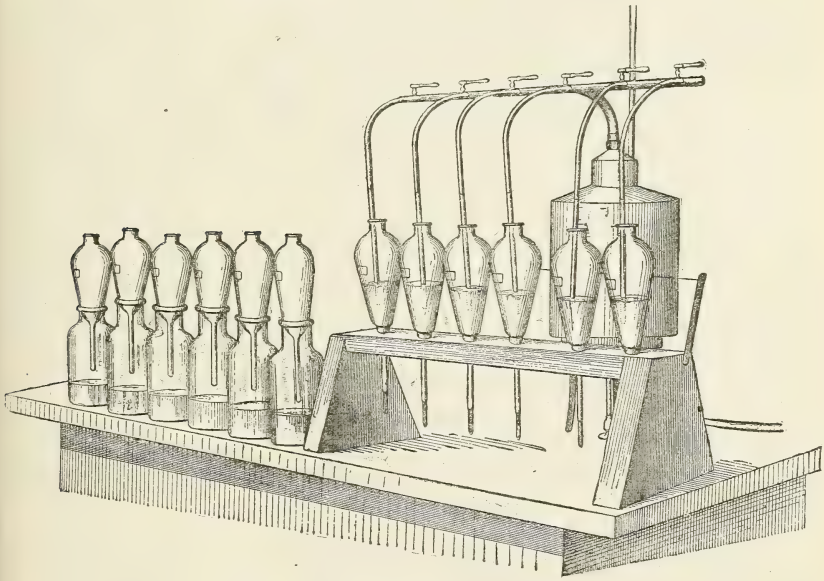

FIG. 4.—Apparatus for determining crude fiber.

wool is placed in the bottom of the bulb, the substance placed on top of this, and the stem of the bulb closed by a rubber tube plugged at one end. The substance is boiled successively with dilute sulphuric acid and alkali, of the strength ordinarily used, by means of steam from a small copper boiler, the steam tube passing nearly to the bottom of the bulb. At the conclusion of each digestion the rubber cap over the stem is removed, allowing the liquid to filter off through the glass wool, and the residue is washed three times with hot water. The filtration can be aided by a filter pump if necessary. After the final washings with alcohol and ether, air is drawn through the substance by a filter pump. The residual crude fiber and glass wool are trans-

*Landw. Jahrb., 1877, Sup., p. 103; Ztschr. anal. Chem., 16, p. 398; and König's Untersuch. Landw. u. Geweb. Stoffe, p. 236.

ferred to a porcelain capsule, dried for at least three hours at 105° to 110°, weighed, ignited with care to avoid melting the glass wool, weighed again, and the loss on ignition taken as the weight of the crude fiber. The nitrogen in the crude fiber is not determined. The process is very rapid, and enables an experienced analyst to complete a large number of determinations in a single day.

DETERMINATION OF FAT.

Crude fat in feeding stuffs is estimated in accordance with the recommendations of the Association of German Experiment Stations in 1890,* which prescribe the exclusive use of ether free from alcohol and water. In the meeting of 1891† the association decided that the dried ether extract need not necessarily be soluble in ether. For the determination, two portions of 5 grams each are weighed out, one in a tared beaker and the other in a cartridge of filter paper. Both portions are dried together in a drying oven at 100°. The portion in the beaker is weighed after drying to ascertain the water content, transferred to a paper cartridge, and both portions then extracted for about ten hours in the familiar Soxhlet extractor. Two batteries of six extractors each are used. The absorption of water from the air by ether during the extraction is guarded against by connecting the upper ends of the condensing tubes with a chloride of calcium bottle. The extraction is continued for about ten hours, generally over night, after which the flask and contents are dried‡ at 100° C. for three hours and weighed. The flasks are cleaned with soda lye, by which they lose about 1 mg. in weight each time. The paper cartridges are used several times over. In the first extraction the cartridge loses about 1 mg. in weight, but the extraction of the paper previous to using is not deemed necessary in ordinary work.

FREE FATTY ACIDS IN FEEDING STUFFS.

At its meeting in 1890§ the Association of German Experiment Stations gave expression to the desirability of estimating the free fatty acids in feeding stuffs as a means of judging of their freshness and quality. This is attempted at the Halle station by treating the ether extract obtained in the extraction just described with 50 c. c. of a mixture of equal parts of alcohol and ether, and estimating the free acid in the solution with standard solution of barium hydrate, using phenolphthalein as indicator. The free acid thus measured is estimated as oleic acid. The result of this determination, however, gives no indication of the character of the fat, and therefore furnishes but little indication of the quality of the feeding stuff.

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* Landw. Vers. Stat., 38, p. 307.

† Landw. Vers. Stat., 40, pp. 60, 67.

‡ Apparently in air.

§ Landw. Vers. Stat., 38, p. 295.

DETERMINATION OF IODINE NUMBER.

At the same meeting of the Association (1890) it was recommended that tests be made of the Hübl method for estimating the iodine absorption as a means of judging of the nature, source, and purity of fats in feeding stuffs, and their freedom from decomposition. Hübl* himself has shown for some fats that the iodine number diminishes with the increasing rancidity of the fat. Further experiments by Reitmair † at the Bonn station, and by Gerlach ‡ at the Halle station, have indicated the following (especially for peanut meal): (1) By drying feeding stuffs in the air previous to their extraction with ether the iodine number of the fats they contain is very materially diminished. The importance of drying under conditions to prevent oxidation, e. g., in hydrogen, purified illumating gas, or over sulphuric acid, is thus apparent. (2) The duration of the extraction has no particular effect on the iodine number. (3) The iodine number decreases but slightly with the age of the feeding stuff. (4) The rancidity of a feeding stuff finds expression in the depression of the iodine number of its fat.

The Hübl method calls for the following solutions: (1) Iodine solution, prepared by dissolving 25 grams of iodine and 30 grams of mercuric chloride each in 500 c. c. of 95 per cent alcohol free from fusel oil, filtering if necessary, and mixing the two solutions. This solution must be allowed to stand twelve hours before being used, and its strength must be determined by titration previous to each series of determinations. (2) Sodium hyposulphite, 24 grams dissolved in 1 liter of water. This is titrated against pure sublimated iodine. (3) Chloroform for dissolving the fat. (4) Aqueous solution of potassium iodide, 1 to 10. (5) Starch solution, 1 gram of starch in 100 c. c. of water.

In making the test 0.2 to 0.3 gram of dry oil, or 0.3 to 0.4 gram of oil not thoroughly dry, or 0.8 to 1 gram of solid fat (in case of feeding stuffs the ether extract is used), is weighed out, dissolved in about 10 c. c. of chloroform, and 20 c. c. of the iodine solution added. If the solution is not perfectly clear after shaking, a little chloroform is added. If the solution becomes colorless after a short time more iodine solution is added, and this is continued until the solution remains brown after standing from one and a half to two hours.§ At the expiration of this time the reaction is ended and it remains to determine the excess of iodine added. This is done by adding 10 to 15 c. c. of the potassium iodide solution diluted with 150 c. c. of water, and titrating with sodium hyposulphite, using starch as an indicator towards the end of the titra-

* Dingler's Polyt. Jour., 253, p. 281; Ztschr. anal. Chem., 25, p. 432.

† Landw. Vers. Stat., 38, p. 389.

‡ Not yet published in detail.

§ Hübl has pointed out that a considerable excess of iodine must be present. Experience at the Halle station and elsewhere has shown an excess of 40 to 50 per cent of iodine to be sufficient.

tion. By "iodine number" is understood the number of parts by weight of iodine absorbed by 100 parts by weight of fat.

MILK ANALYSIS.

The analysis of milk at the station involves principally the determinations of specific gravity, fat, and solids. Milk is analyzed as soon as received, if practicable; if not a few drops of ammonia are added and the sample kept in a cool place. In preparing the milk for analysis it is warmed to 40° or 45° in a water bath in the bottle in which it was received and shaken at intervals of five minutes during half an hour, to secure uniform distribution of the fat globules. It is then cooled to 17° to 18°, with occasional shaking. The specific gravity is determined with a lactodensimeter at 17° to 18°, the reading corrected for a temperature of 15° C., and the fat determined by the Soxhlet aërometric method.* The percentage of solids is estimated from the specific gravity and per cent of fat by the Fleischmann † formula, tables being used to facilitate the calculation.

In exceptional cases the determinations of both solids and fat are made gravimetrically. In such cases both are estimated in the same sample by drying 10 c. c. of milk on sand in a Hoffmeister glass capsule for solids, and then grinding the capsule and residue in a mortar and extracting with ether in a Soxhlet extractor for fat.

Fat in butter is determined gravimetrically in the same manner.

DETERMINATION OF NITROGEN.

The methods used for determining nitrogen are the Kjeldahl or Kjeldahl-Jodlbaur method, the Schlösing-Wagner method, and a specially devised method for nitrate of soda. The soda-lime and absolute methods have been discarded.

Kjeldahl method.—This is carried out as usually prescribed. Mercury is added during digestion but no potassium permanganate. During the digestion the flask is closed by a loosely fitting glass bulb. The tripods used for holding the digestion flasks are circular and hold six flasks each. There are six of these tripods placed under a large hood. The flasks are distinguished by numbered lead tags about the necks.

The digestion ended, the solutions are transferred to the distilling flasks, likewise numbered with lead tags, and the ammonia distilled off in the ordinary way, except that the steam is not cooled, but conducted directly into the sulphuric acid through tubes about 30 inches long.

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* Gebrauchsanweisung für Ausführung der aräometrischen Methode zur Bestimmung des Fettgehaltes der Milch, von Soxhlet, 1888; also König's Untersuchung landw. Stoffe, p. 353.

† $t=1.2f+2.665\,\frac{100s-100}{s}$, in which s = specific gravity of the milk at 15° C., f= per cent of fat in the milk, and t = per cent cent of solids. Jour. Landw., 33 (1885), p. 251.

The acid used for collecting the ammonia is prepared by diluting 1,524 grams of pure concentrated sulphuric acid of 1.845 specific gravity to 40 liters, and its strength is determined by chemically pure carbonate of soda. This acid is diluted with 50 c. c. of water, which is said to render the absorption of the ammonia complete. The hot steam causes the acid to boil, which dissipates any carbonic acid. Repeated blank determinations have shown that no appreciable error results with this all-glass apparatus. Twelve determinations are conducted simultaneously in the apparatus shown (Fig. 5).

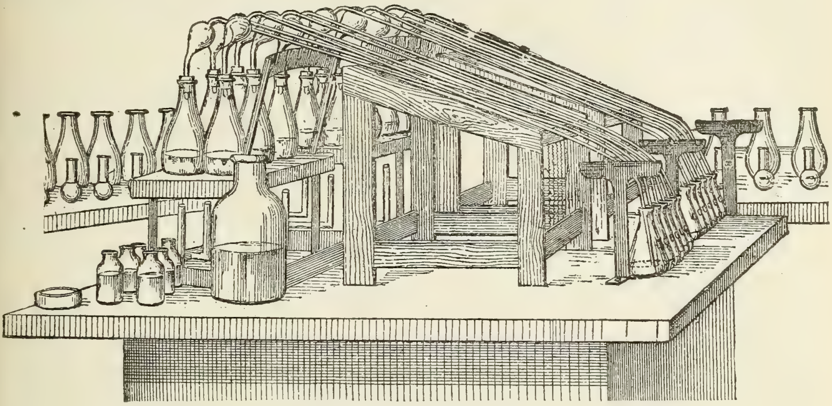

FIG. 5.—Kjeldahl distillation.

The final titration of the acid is made with standard barium hydrate solution, using rosalic acid as indicator.

With the apparatus as arranged in the Halle laboratory and the system followed, a chemist accustomed to the work is able to make seventy-two determinations of nitrogen in a working day of nine hours, provided the samples do not require special preparation.

Kjeldahl-Jodlbaur method.—For fertilizers in which part of the nitrogen exists as nitrates, and for soils, the Kjeldahl-Jodlbaur method is employed, using 30 c. c. of a mixture prepared by dissolving 66 grams of phenol and 250 grams of phosphoric anhydride, each in concentrated sulphuric acid, and adding the cooled solutions to enough concentrated sulphuric acid to make the whole volume 1,650 c. c. Phosphates containing nitrate of soda are mixed with gypsum (10 grams of each), triturated, and 2 grams taken for analysis. When the mixtures contain over 8 per cent of nitrogen, only 1 gram is used. After an hour the nitrophenol is reduced to amidophenol with 2 to 3 grams of zinc dust. The flasks are allowed to stand two hours after the reduction is completed. The digestion (with mercury) is then made as in the Kjeldahl method.

In the distillation 105 c. c. of soda solution is used instead of 60 c. c., as there is considerable phosphoric acid to be neutralized.

The use of salicylic acid and sodium hyposulphite, as described by Förster,* has the advantage that the cooling after the reduction is not necessary, but, on the whole, the experience at the station has not led to its being preferred to the Jodlbaur modification.

Ammonia compounds.—When nitrogen in the form of ammonia alone is to be determined, as in sulphate of ammonia, either 50 c. c. of a solution prepared by dissolving 20 grams in a liter of water, or the substance itself, is distilled with water and magnesia.

Nitrate of soda.—Until lately the nitrogen in nitrate of soda was estimated indirectly. The difference between 100 and the sum of the water, chlorides, and sulphates, allowing 0.2 per cent for other impurities, was assumed to represent the pure sodium nitrate.

In pursuance of a recommendation of the Association of German Experiment Stations in 1890 that a direct method be sought, the Halle station investigated the current methods and chose the Kjeldahl-Jodlbaur method and that of reducing to ammonia with zinc, iron, and soda lye, as practiced for some time previously at the Möckern station, as the two most reliable methods. The latter method is used extensively at the station.

Zinc-iron method for nitrates.—For the determination, 0.5 gram of the nitrate (50 c. c. of a solution of 10 grams in 1 liter of water), about 5 grams of zinc dust, the same quantity of iron filings (measured out), 75 c. c. of water and 80 c. c. of soda lye of 1.3 specific gravity are mixed in a distilling flask and after standing for an hour in the cold the ammonia is distilled off. The ammonia and steam pass through a cooler with block-tin condensing tubes, and are received in Erlenmeyer flasks containing 20 c. c. of standardized sulphuric acid. The evolution of hydrogen is very active and an arrangement to prevent the soda solution from being carried into the condensing tube is indispensable. About 100 c. c. are distilled over and titrated with barium hydrate solution. The relation of standard acid to standard alkali is found from a series of blank determinations instead of by direct titration, as the two results do not exactly agree. With this precaution the nitrogen determinations agree very closely with those by the Kjeldahl-Jodlbaur method. Twenty-four determinations a day are made with the method and apparatus described.

Schlösing-Wagner method.—When the nitrogen of nitrates in mixed fertilizers is to be determined independently of the total nitrogen the Schlösing-Grandeau-Wagner method is used.† The method, as is well known, depends on liberating the nitric nitrogen as nitric oxide by boiling with ferrous chloride and hydrochloric acid, and measuring the volume of the generated gas. The decomposition is carried on in a flask of 200–300 c. c. capacity, provided with a funnel supply tube and an

*Ztschr. anal. Chem. 28, 1889, p. 422.

†Konig's Untersuch. landw. Stoffe, p. 151; and Böckmann's Chem. tech. Untersuchungsmethoden, 3d edition, I, p. 329.

evolution tube. The nitric oxide is collected over potash solution. At the outset 50 c. c. of 10 per cent hydrochloric acid and the same volume of concentrated ferrous chloride solution are introduced into a flask and boiled until all the air has been driven out through the evolution tube. Then 10 c. c. of a normal nitrate solution, containing 2.5 grams of pure sodium nitrate in 100 c. c. is placed in the funnel. The stopper of the latter is turned so as to allow the nitrate solution to drop slowly into the flask, and the last portions are washed in with hydrochloric acid. The nitric oxide is collected in a eudiometer. When the evolution has ceased another eudiometer is placed over the end of the delivery tube and the first is suspended in a cylinder of distilled water. Ten c. c. of a solution of the nitrate to be determined is then put in the funnel tube and the process repeated as described. Determinations of a series of samples are thus made in rapid succession, ending with a second one of the normal nitrate solution. The comparison of the volumes of gas liberated from the normal solution and the substances analyzed gives the weight of nitrogen in the latter directly without corrections for temperature and pressure. Fifty c. c. of ferrous chloride solution and the same quantity of hydrochloric acid suffice for a dozen determinations.

Albuminoid nitrogen in feeding stuffs.—The percentage of nitrogen in feeding stuffs multiplied by 6.25 is taken as the measure of the total nitrogenous matter (protein), and the so-called actual albuminoid nitrogen is estimated by Stutzer's method.* At the Halle station determinations of actual albuminoids are made not only in potatoes, roots, and ensiled beet leaves, but especially in coarse fodders and in new kinds of commercial feeding stuffs of which the nutritive value is to be determined.

ARTIFICIAL DIGESTION.

The digestibility of the nitrogen compounds in feeding stuffs is estimated by Stutzer's method,† though with some minor modifications of detail. The digestions with pepsin and with pancreas are conducted in a pear-shaped glass bulb similar to that used for crude fiber determination, a wad of glass wool being placed in the bottom of the bulb and the stem closed with a rubber tube plugged at one end. The bulbs are kept at the desired temperature (37° to 39°) during digestion by a large water bath with openings for a large number of bulbs. The details are carried out as commonly described.

FIG. 6.—Digestion bulb.

*Jour. Landw., 29 (1881), p. 473; also Proc. Conv. Ass. Off. Agr. Chem., 1892, p. 215.

†Jour. Landw., 28, p. 201; 29, p. 475; Ztschr. physiol. Chem., 9, p. 211; 11, pp. 207, 537; Landw. Vers. Stat., 36, p. 321; 37, p. 107; 38, p. 277. See also König's Untersuch. landw. Stoffe, pp. 219, 689.

DETECTION OF GROUND HORN ETC., IN GROUND BONE.

In analysis of ground bone the Kjeldahl method, of course, affords no means of distinguishing admixtures of such nitrogenous materials as ground horn and the like. The difference in specific gravity makes it practicable to separate the latter by means of chloroform. To this end 5 grams of substance are shaken repeatedly with chloroform in a test tube. The fine particles of bone settle slowly while the lighter ground horn rises to the surface. After each treatment with chloroform the supernatent liquid is poured off. The portions containing the ground horn are collected and allowed to stand a considerable time in order that any finer particles of bone which may have been poured off with the horn may settle out. Finally the supernatent solution is filtered and the nitrogen determined in the residue left on the filter (ground horn).

By adding such nitrogenous materials as ground horn and blood to ground bone from which the nitrogenous material has been removed for making glue, the composition of the mixture, *i. e.*, the ratio of nitrogen to phosphoric acid, is made to approach that of pure steamed or raw ground bone. The ratio of nitrogen to phosphoric acid after extraction with chloroform ranges for pure steamed bone between 1:4 and 1:8.5; and for treated bone, from which the glue substance has been removed, between 1:8.5 and 1:30. The separation by chloroform thus affords an indication of such adulteration.

DETERMINATION OF PHOSPHORIC ACID IN FERTILIZERS.

Water-soluble phosphoric acid.—The solution is made by shaking 20 grams of substance in a thick liter bottle with 800 c. c. of water for thirty minutes. The bottle is then filled to the liter mark, the contents mixed and filtered, and aliquots of 50 c. c., corresponding to 1 gram of substance, taken for the determination of phosphoric acid as described under total phosphoric acid. The shaking machine is usually run by a gas or water motor.

Reverted and insoluble phosphoric acid are determined by practically the same methods employed by official chemists in this country.

Total phosphoric acid.—Except in the case of Thomas slag the solution for total phosphoric acid is prepared by boiling 5 to 10 grams of the phosphate in a half-liter flask with 20 c. c. of nitric acid of 1.42 specific gravity and 50 c. c. pure concentrated sulphuric acid for half an hour. After cooling the solution is diluted to 500 c. c.

The use of hydrochloric acid for dissolving phosphate has, according to the experience of the station, the disadvantage that large quantities of lime and alumina are dissolved and enough of them precipitated with the ammonium-magnesium phosphate to more than compensate for

the amount of the latter left in the solution, so that the results are generally too large. This is not the case with sulphuric acid, and the latter has also the advantage that at the boiling temperature it does not dissolve silica. In the investigations of Bühring the safety and accuracy of the citrate method (described below) when sulphuric acid is used are demonstrated by hundreds of analyses in which it has been compared with the molybdic method.

Thomas slag is dissolved in sulphuric acid alone, since the nitric acid might dissolve enough lime to interfere with the determination of the phosphoric acid by the citrate method, as explained beyond.

In the case of double superphosphates which sometimes contain phosphoric acid in the tetra-basic form (pyrophosphate), the solution is digested with nitric acid to change the phosphoric acid to the tri·basic form. To 25 c. c. of the solution 75 c. c. of water and 10 c. c. of nitric acid of a specific gravity of 1.42 are added and the whole is heated on the sand bath until the volume is reduced to 25 c. c. After addition of a drop of rosalic acid to the strongly acid solution, it is made alkaline with ammonia, slightly acidified with nitric acid, and is then ready for the determination of phosphoric acid.

Citrate method for phosphoric acid.—For the determination of phosphoric acid the citrate method* with slight modifications, is very generally employed in the Halle laboratory, recourse being had to the molybdic method only in exceptional and disputed cases. The various ways for carrying out the details of this method which have been proposed from time to time, have been tested at the station by L. Bühring. From his extensive investigations a plan has been worked out which has been in use at Halle for more than five years. The principle of the method consists in precipitating the phosphoric acid from solution in water, nitric acid, or sulphuric acid by magnesia mixture in the presence of a large amount of ammonium citrate, which prevents the precipitation of lime, alumina, iron, and other bases. That is to say, very small quantities of other bases are precipitated and a very small amount of the ammonium-magnesium phosphate remains in solution, but experience has shown that the two errors compensate each other when the operation is performed with proper precautions. The precipitate is washed with water containing ammonia, ignited and weighed as pyrophosphate.

The ammonium-citrate solution is made at Halle by dissolving 1,500 grams of citric acid in water, adding 5 liters of 24 per cent ammonia solution, and diluting with water to 15 liters.

For the magnesia mixture 500 grams of magnesium chloride, 3½ liters of 24 per cent ammonia solution, and 6½ liters of distilled water are employed.

*See accounts of discussion of this method by the Association of German Stations. Landw. Vers. Stat., 37, p. 295.

Fifty c. c. of the solution of soluble or total phosphoric acid, prepared as described above, or 25 c. c. of the solution of double superphosphate, are measured into an Erlenmeyer flask and the ammonium citrate, 50 c. c. for soluble and 100 c. c. for insoluble phosphoric acid or Thomas slag, is added, together with 25 c. c. of magnesia mixture. These solutions are both run in from burettes. No permanent turbidity should follow the addition of the citrate solution; the precipitate which commonly appears at first must disappear when the whole has been added. It is advantageous on this account to shake the Erlenmeyer flask while the citrate is being added.

In solutions of boneblack superphosphate a permanent opalescence is apt to occur, but it does not affect the determination since the particles pass through even the best asbestos filter. If, as is seldom the case, it happens that in working with phosphates rich in iron and alumina, 50 c. c. of the citrate is insufficient to hold the bases in solution, 25 c. c. more can be used without danger of affecting the result of the analysis.

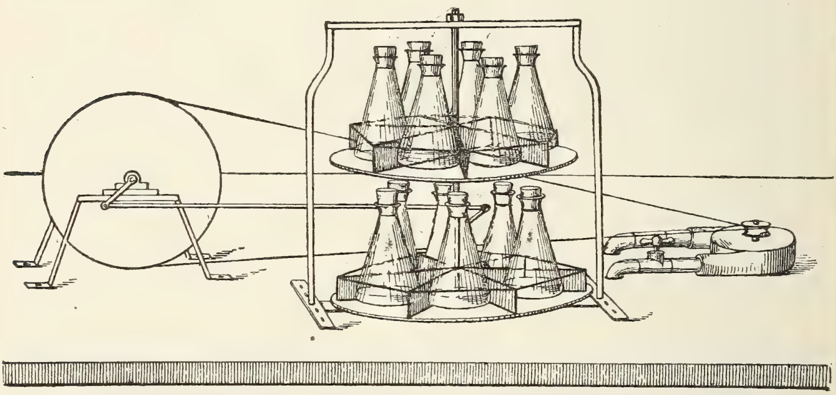

FIG. 7.—Shaking apparatus to aid precipitation of ammonium-magnesium phosphate.

After adding the ammonium citrate the solution is cooled and the magnesia mixture is added as soon as possible to anticipate a possible separation of crystalline calcium phosphate. To facilitate the separation of the ammonium-magnesium phosphate, and to prevent it from adhering to the sides of the precipitating flasks, the latter are shaken for half an hour by a machine holding twelve flasks and run by a small turbine (Fig. 7).

The solutions are filtered through Gooch crucibles. For transferring and washing the precipitates, water containing 5 per cent of ammonia is used. This wash solution is contained in an elevated reservoir, and is used with a long rubber tube, instead of the ordinary wash bottle (Fig. 8).

The reservoir holds 20 liters, and is provided with two glass tips connected with it by a Y-tube, one with a fine and the other with a

coarser opening, the former for washing the precipitate out of the flask, and the latter for washing it on the filter.

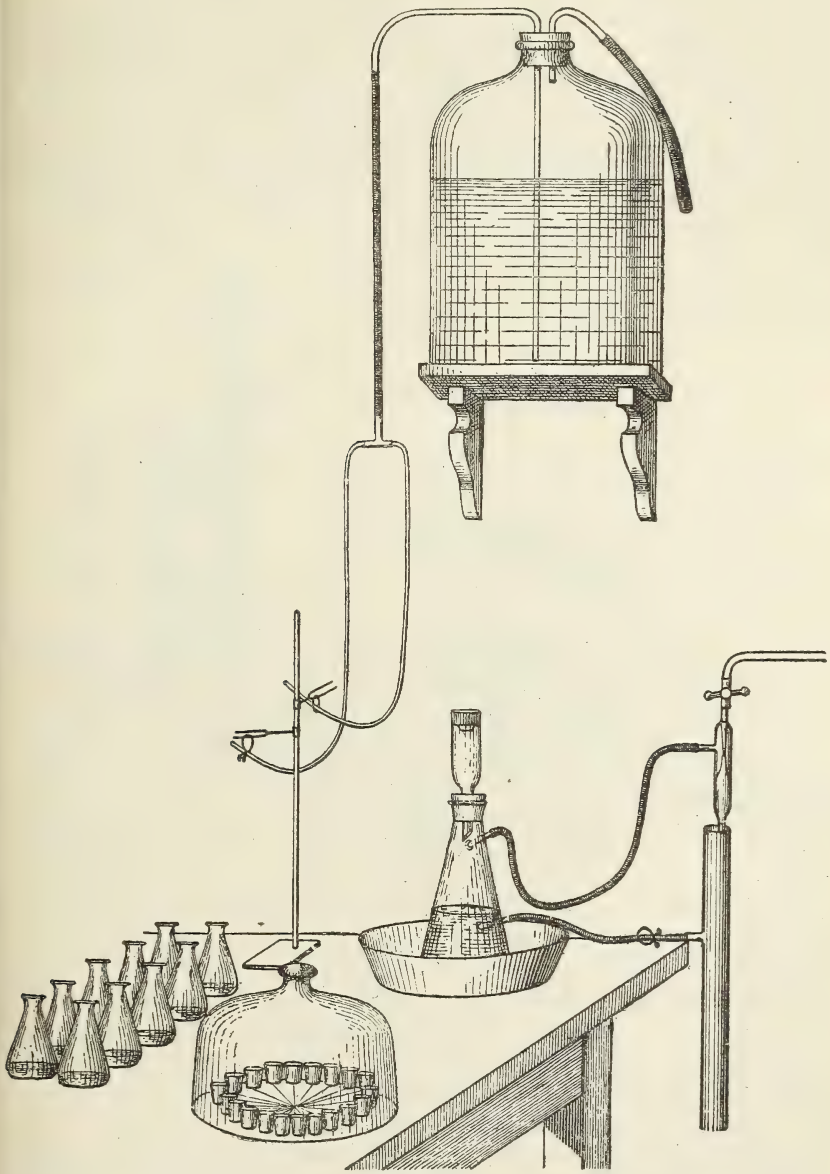

FIG. 8.—Filtering ammonium-magnesium phosphate precipitates.

The crucibles are first heated on an iron plate and then ignited in a Rossler's muffle furnace, after which they are rapidly cooled by placing in depressions in a zinc box with water running through it. A number

of copper cups, into which the crucibles fit, are inserted in the cover of the box, as shown in the figure below (Fig. 9).

The same crucible is used for filtering and igniting several successive precipitates, generally ten or twelve, without cleaning it out. When the accumulated precipitates half fill the crucible they are removed without disturbing the asbestos filter; the crucible is then weighed and is ready for another series of precipitates. The filters are thus used as long as they remain impervious to the precipitate.

The maximum limit of difference between duplicate determinations is fixed at 1.2 mg. of magnesium pyrophosphate when 0.5 gram of substance is used or 2.4 mg. when 1 gram is used.

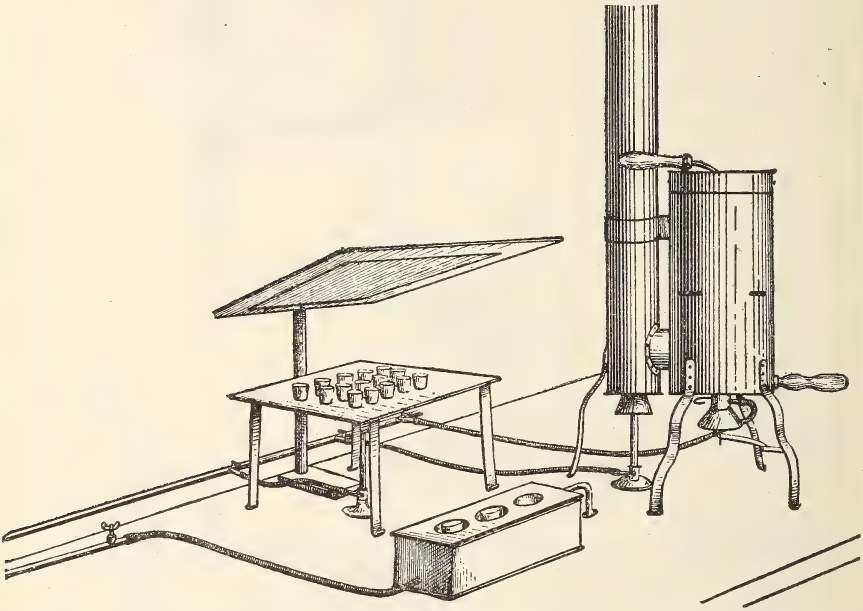

FIG. 9.—Apparatus for igniting and cooling ammonium-magnesium phosphate precitates.

During the height of the fertilizer season, in spring and fall, four of the station chemists are employed exclusively in making phosphoric acid determinations. Two prepare the solutions and carry on the operations up to the filtration of the ammonium-magnesium phosphate precipitates; a third does the filtering, while a fourth ignites and weighs the crucibles. When the work is well under way this force is able to make 100 determinations in a day of eight hours.

Molybdic method.—The details of manipulation of this method differ slightly from those followed by station chemists in this country. The phosphoric acid solution is digested with molybdic solution at 50° for three hours, instead of at 65° for one hour, as recommended by the Association of Official Agricultural Chemists; the yellow precipitate is washed by decantation with dilute (1:1) molybdic solution, instead of

"with water or ammonium-nitrate solution;" and the molybdic solution used is prepared by dissolving 150 grams of molybdate of ammonia in 1 liter of water, and pouring this into a liter of nitric acid of 1.2 specific gravity.

Free phosphoric acid.—It is sometimes desirable to determine the free phosphoric acid in the so-called gypsum superphosphate, the residue from the manufacture of double superphosphate. To this end, 5 grams are triturated in a mortar with absolute alcohol and then transferred to a 250 c. c. flask, which is then filled to the mark with absolute alcohol, closed with a cork, and allowed to stand two hours with frequent shaking. The liquid is filtered as rapidly as possible and 50 c. c. of the filtrate, corresponding to 1 gram of substance, is then taken for the determination. This quantity is carefully evaporated to dryness on a water or sand bath, taken up in water, and treated further like a solution of soluble phosphoric acid.

DETERMINATION OF PHOSPHORIC ACID IN SOILS.

The solution is prepared by boiling 25 grams of soil (half this amount of clay soil) with 20 c. c. nitric acid and 50 c. c. concentrated sulphuric acid for half an hour, and making to 500 c. c. For the determination of phosphoric acid 100 c. c. is taken, 20 c. c. of 24 per cent ammonia added to neutralize the acid, 50 c. c. of citrate solution, 20 c. c. more of the ammonia, and then 25 c. c. of magnesia mixture. The solution is allowed to stand forty-eight hours before filtering.

Available phosphoric acid in soils.—An effort has been made at the station to discover a method by which may be determined the approximate proportion of the phosphoric acid in soils which is available to plants. Organic acids, especially citric, have been experimented with. Comparisons have been made between the amounts of phosphoric acid dissolved by reagents in laboratory tests, and the amounts actually assimilated by plants in pot experiments. The vegetation experiments are made by the Wagner method, described in the previous article (p. 378). The following method, devised by Dr. Gerlach, is used for the laboratory test Sixty grams of soil is digested in the cold with 300 c. c. of 2 per cent citric acid for twenty-four hours with agitation once in five or six hours, after which 200 c. c. of the solution is filtered off and evaporated to dryness. Except in rich lime soils the residue is sirup-like. The silica is separated by heating the residue with 20 c. c. of concentrated sulphuric acid and 5 c. c. of fuming nitric acid, and diluting with water. Of the filtrate 100 c. c. (extract from 20 grams of soil) is made slightly alkaline with ammonia, then slightly acid with hydrochloric acid, and the phosphoric acid determined in the solution by the citrate method, allowing the precipitate to stand forty-eight hours before filtering. In a considerable number of trials made thus far a parallelism has been apparent between the proportion of phosphoric acids found in soils by this method and the quantity of product realized in growing plants in the soil with the

aid of other fertilizing materials, but without the addition of phosphoric acid. However, the results are not yet sufficiently complete to warrant definite statements.

DETERMINATION OF FINE MEAL IN THOMAS SLAG.

By fine meal is understood that portion of the slag which passes a sieve of 0.17 mm. meshes. The determination is made according to the regulations adopted at the Bonn meeting of the Association of German Experiment Stations.* Fifty grams of ground slag is shaken for 15 minutes in a sieve not less than 20 cm. in diameter and made of wire gauze No. 100, Amandus Kahl, Hamburg. The shaking may be done by a machine. The difference between the slag taken and that remaining in the sieve is taken as fine meal.

TEST OF THOMAS SLAG FOR ADULTERATION.

The only adulterant of Thomas slag observed at the station is Redonda phosphate. This material consists principally of aluminic phosphate whose phosphoric acid is said to have no value as a fertilizer for plants. Several methods have been elaborated for determining adulteration of Thomas slag, and after tests of these at the station by Dr. Morgen and Dr. Gerlach the following have been adopted.

According to Richters,† 2 grams of Thomas slag meal is mixed in a test tube with about 10 c. c. of sodium hydrate of 1.05–1.06 specific gravity and allowed to stand for an hour with frequent shaking. The supernatent liquid is filtered off, acidulated with hydrochloric acid and ammonia added until the solution is slightly alkaline. If the slag is unadulterated there should be no precipitate on adding the ammonia, or at the most only a slight flocculence. If, on the contrary, as much as 5 per cent of Redonda phosphate is present a gelatinous precipitate of aluminic phosphate appears, which on standing absorbs nearly half of the liquid. A further indication of impurity is a more or less intense yellow or brownish color of the solution in sodium hydrate, and also the appearance of a precipitate when hydrochloric acid is added drop by drop to the alkaline solution.

The Richters method is not absolutely reliable in all cases. For instance, in some cases a precipitate of considerable size appears upon adding ammonia which leaves some doubt as to the purity of the slag. In such cases Dr. Gerlach recommends to shake 5 grams of the slag in a test tube with 10 to 15 c. c. of bromoform. If the slag is pure there is little or no separation, but if Redonda phosphate is present a large portion of it rises to the surface. In the latter case the material rising to the surface may be collected on a filter and tested by the Richters method just described, using preferably only 5 c. c. of sodium hydrate.

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*Landw. Vers. Stat., 35, p. 444.

†Morgen. Chemische Industrie, 1891.

Another method of distinguishing between pure and adulterated slag is the water content. While pure slag contains only a trace of water, Redonda phosphate contains water in a considerable amount. Accordingly 5 grams of slag is dried in a platinum dish in a bath at 100° for three hours and then ignited for fifteen minutes. If there is little or no loss on ignition, or, as more frequently happens, a slight increase in weight, the indication is that the slag is pure; but a loss of 5 per cent in weight on ignition renders the sample suspicious. On careful examination brown particles of Redonda phosphate may often be seen in the slag.

For the quantitative determination of the adulterant, the method of Schucht is highly recommended, and as shown by numerous experiments by Dr. Gerlach gives very reliable results. The method is as follows: 1 gram of slag is digested on a water bath at 50 to 70° with 150 c. c. of Jentsch's citric acid solution, containing 50 grams of crystallized citric acid to the liter. After diluting with 100 c. c. of water and boiling for a minute the solution is filtered, the residue washed on the filter with hot water, and the undissolved phosphoric acid in the residue determined. As it has been found in numerous experiments that the phosphoric acid in Thomas slag is dissolved to a minimum of about 0.1 per cent in Jentsch's citric acid solution, and that that of Redonda phosphate is practically insoluble in the solution (only a few hundredths of a per cent dissolved), the method is considered as well adapted to the quantitative determination of Redonda phosphate in Thomas slag.

DETERMINATION OF POTASH.

Potash in potash salts.—Five grams of substance is boiled in a half-liter flask with 20–30 c. c. of concentrated hydrochloric acid diluted with 100 c. c. of water for thirty minutes. The flask is then filled two thirds full with water, and barium chloride slowly added to the hot solution. Care is taken not to add the barium chloride in excess, and if an excess is added it is precipitated by a little sulphuric acid. The solution is cooled, the flask filled to the mark with water, and filtered. Fifty c. c. of the filtrate, corresponding to 0.5 gram of the substance, is evaporated on a water bath with 10 c. c. of platinic chloride (containing 1 gram of platinum) to a sirup, and about 80 per cent alcohol added to the residue. The precipitate is collected in a Gooch crucible bottom, washed several times with 80–82 per cent alcohol, and the potassium-platinic chloride dried two hours at 100°. After weighing, the potassium-platinic chloride is dissolved out with hot water, the filter (crucible) is washed first with hot water and then with alcohol, dried, and weighed. The difference in weight represents the weight of pure potassium-platinic chloride. The limit of error is fixed at 0.25 per cent.

Potash in fertilizers containing organic matter.—Ten grams of substance is charred in a crucible and the residue dissolved in hydro-

chloric acid to which a few drops of nitric acid are added. An aliquot of the solution is treated with barium chloride as before, the filtrate from this neutralized with ammonia and treated with ammonium carbonate. An aliquot of the filtrate is evaporated to dryness in a platinum dish, the ammonia driven off by heat, the residue taken up in hot water, filtered to remove magnesia, acidulated with a few drops of hydrochloric acid, and then treated with platinic chloride as above.

Potash in soils.—One hundred grams of soil and 500 c. c. of 40 per cent hydrochloric acid are placed in a liter flask, the flask filled to the mark, and allowed to stand for forty-eight hours with frequent shaking. The solution is filtered off and an aliquot evaporated for the potash determination, which is made as described for fertilizers containing organic matter.

SOIL ANALYSIS.

The methods for soil analysis adopted by the Association of German Experiment Stations in 1890 are used at the Halle station. Some of these have already been described. For a fuller account the reader is referred to the original description of the methods of the station.

EXAMINATION OF SOAP.

In soap the fatty acids, alkali, and water are quantitatively determined, and tests made for free alkali.

For the determination of fatty acids 5 grams of soap is heated with 150 c. c. of 5 per cent sulphuric acid until it is decomposed and the freed fatty acids collect at the surface. A weighed amount (10 grams) of shaved paraffin is added and melted with the fatty acids and, after cooling, the liquid beneath the fat layer is poured off. The fat layer is purified by melting in hot water several times and pouring off the water after each operation; any fatty acids rising on the liquid just poured off are added, and after a final washing with hot water the fat layer is dried to constant weight in a vacuum (forty-eight hours). From the weight is subtracted the paraffin added, and the per cent of fatty acids is then calculated, making allowance for the water of constitution (3.25 per cent).

The alkali content is found by charring 3 grams of hard or 5 grams of soft soap, adding 20 c. c. of the sulphuric acid used in the Kjeldahl determination to the residue, heating for ten minutes to expel the carbonic acid, and titrating the excess of acid with barium hydrate.

Water is determined in 5 grams by heating in an air bath at 110° for forty-eight hours.

The test for free alkali is made with a solution of mercurous oxide; the presence of free alkali is indicated by a dark colored precipitate.

WATER ANALYSIS.

The methods employed in water analysis are largely those in common use by chemists in this country.

DETERMINATIONS OF STARCH AND SUGAR.

In connection with the investigations at the station of the sugar beet and alcohol industries, the determinations of starch and sugar assume considerable proportions. The methods employed are described in full in Prof. Maercker's work on alcohol manufacture.*

As a reliable and direct method for determining starch is lacking, the method used depends upon inverting the starch with dilute acids and determining the dextrose. In this, the recommendations of Maercker and Morgen are followed.† Three grams of starch is made

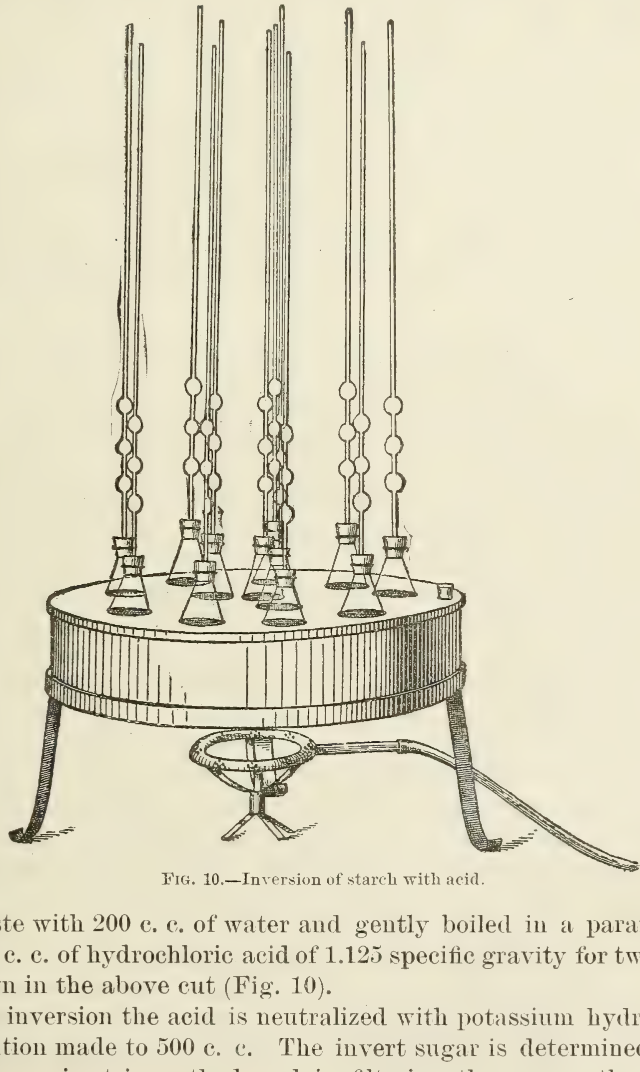

FIG. 10.—Inversion of starch with acid.

to a paste with 200 c. c. of water and gently boiled in a paraffin bath with 15 c. c. of hydrochloric acid of 1.125 specific gravity for two hours, as shown in the above cut (Fig. 10).

After inversion the acid is neutralized with potassium hydrate, and the solution made to 500 c. c. The invert sugar is determined by the Fehling gravimetric method, and in filtering the copper the Soxhlet

*Handbuch der Spiritusfabrikation. †Ibid, 1890, p. 78.

filtering tubes are used. These tubes are about 2 cm. in diameter and 12 cm. long, drawn out to a narrow stem at one end. Glass wool or a fine platinum cone is placed in the bottom (stem) of the tube, and shredded asbestus suspended in water is poured in upon this, forming a close layer of asbestus like that in a Gooch crucible. It is mentioned that not all asbestus is found to answer this purpose, as some kinds lose considerable in weight (10 mg. and more) by filtering the alkaline Fehling solution and cleaning with nitric acid. Further, even the best quality of asbestus loses in weight during the first few operations so that it is essential to make a number of blank determinations after preparing a tube anew. The weight of the tube should not vary more than 1 to 2 mg. from one determination to another.

The tube with the copper precipitate is dried at 110° for an hour, and the copper reduced by passing a current of hydrogen through the gently heated tube. After the metallic copper has been weighed, the tube is cleaned with nitric acid and dried. It is considered more exact to deduct the weight of the tube at the end than at the beginning of the determination, since, as explained above, the tubes very often lose from 1 to 2 mg. in weight by filtering the alkaline Fehling solution. The tubes are used repeatedly, renewing the asbestus only when it ceases to filter satisfactorily.

The tables of Allihn and Wein are used in calculating the results. In consequence of the weaker reducing power of maltose, it must be boiled with the Fehling solution for four minutes.

In potatoes and grains—Potatoes and grains are treated with diastase, or at a high pressure.

For the former method 3 grams of finely ground material is extracted with ether when necessary and boiled with 100 c. c. of water for 30 minutes. After cooling to 65°, 10 c. c. of normal malt extract (100 grams of malt to 1 liter of water) is added, the temperature kept at 65° for 30 minutes, and the solution then boiled for 15 minutes. This is repeated three times, using 10 c. c. of malt extract each time, after which the volume of the solution is made to 250 c. c. and 200 c. c. of the filtered solution inverted with hydrochloric acid and treated as described above, deducting of course the dextrose content of the malt extract from the final result.

The inversion under pressure is carried on either in Lintner pressure bottles or a small steam boiler. The latter is ordinarily used at the Halle station, 3 grams of finely ground substance being mixed in a metal vessel with 25 per cent lactic acid and 30 c. c. of water, the vessel closed, and treated at a pressure of three and a half atmospheres for two and a half hours. All determinations are made in triplicate and a number of vessels are treated in the boiler at once. The contents of the metal vessel are diluted with 50 c. c. hot water, transferred to a flask, made to 250 c. c., filtered after standing a half hour, 200 c. c. of

the filtrate inverted with hydrochloric acid, etc. This method (Reinke's) is said to give results at least 3 per cent too high except in case of materials which it is essential to treat at high pressure, where it gives fairly correct results. It is very essential that the material be ground to an impalpable powder. Potatoes are cut into slices which are strung on strings, dried and finally ground in the Dreefs mill.

The method of determining the starch content of potatoes by the specific gravity is also employed in some cases, using either the Reimann, Schwarzer, or Hurtzig balance, preferably the latter. The errors of this method amount to from 1 to 2 per cent.

In mash.—In exact determinations of the fermentable substances or of the amounts of separate kinds of sugars in mash the saccharometer test of Balling or Brix, commonly used, is replaced by the Fehling test. The simplest of these determinations is that of maltose, since this can be determined directly in the diluted mash. When the total content of fermentable carbohydrates is to be determined the mash must be inverted, and these materials determined as dextrose; 50 c. c. of (filtered or unfiltered) mash is diluted to 1 liter with water, filtered after standing a half hour, and 200 c. c. inverted with hydrochloric acid and tested with Fehling solution, as already described. When very exact results are desired or the sugar in fermented mash is to be determined, 2 to 3 c. c. of acetate of lead is added to precipitate any other substance which would give a precipitate with the copper solution, and the lead removed by adding sulphuric acid or sodium sulphate.

The acidity of mash is found by titrating with normal potash or soda and testing with litmus paper, and is expressed in terms of the c. c. of normal alkali solution required to neutralize 20 c. c. of mash.

In the analysis of fermented mash the most important determination is that of alcohol. In practice this is almost invariably made in the filtered mash on account of the frothing of the unfiltered mash in process of distillation; but when this is done a correction is necessary for the brewers' grains removed by filtering, and this gives rise to some uncertainty in the final result. For this reason it is considered preferable to determine the alcohol in the unfiltered mash, and this method is followed at the Halle station. Alcohol is determined exclusively by distillation. Commonly 500 c. c. of mash is diluted with an equal volume of water and then slowly distilled in a metal retort of 4 or 5 liters capacity, heated in a paraffin bath; 500 c. c. is distilled off. If the mash froths badly paraffin is added to it. The alcohol in the distillate is determined by an alcoholometer.

ANALYSIS OF SUGAR BEETS.

Upon receipt of the beets at the laboratory they are cleaned, dried, assorted into large, small, and medium, and each portion weighed. The whole lot is divided into two equal parts and all the beets of one

lot analyzed. If the number is small the beets are grated by hand, if large by a segment grater which is run by power, made for the station by Keil & Dolle, of Quedlinburg, Germany (Fig. 11). This grater removes a segment of the beet equivalent to one tenth or one twelfth of its volume. The grater has given excellent satisfaction; it grinds the pulp and gives an average sample in small volume. From a portion of the mixed pulp a sample is taken for determining the sugar in the beet, and another for expressing the juice, which is done in a hydraulic hand press, by which a pressure of 300 atmospheres may be exerted. From every portion of pulp two samples are pressed

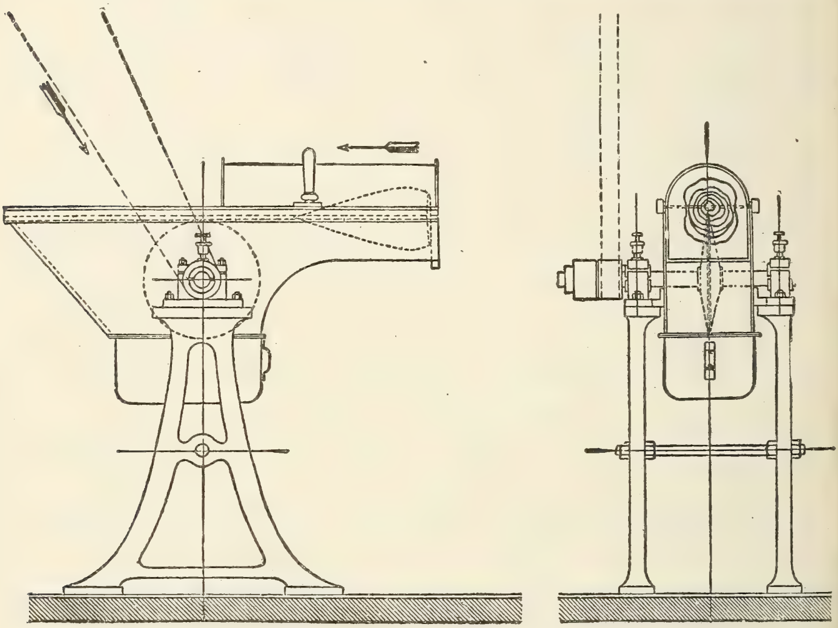

FIG. 11.—Segment grater for sampling sugar beets.

separately and then united and pressed again. The expressed juice is stirred thoroughly and allowed to settle for two hours, then siphoned off and tested with a Brix saccharometer. Fifty cubic centimeters of the juice are also measured into a 100 c. c. flask, 3 c. c. acetate of lead added, and the flask filled to the mark with 90 to 92 per cent alcohol and allowed to stand a half hour, filtered, and polarized.

The beet pulp is thoroughly mixed again, 52.096 grams (double normal weight) weighed out in a metal dish and washed into a flask of 201.5 c. c. capacity with 90 to 92 per cent alcohol. Three cubic centimeters acetate of lead is then added, the flask nearly filled with alcohol, and digested in a water bath at 73° to 76° for a half hour. After cooling the flask is filled to the mark with alcohol, the contents mixed by shaking, filtered through a double fluted filter, and polarized. In this as in other operations, a large number of analyses are carried on simultaneously.

For the polarizations a Schmidt & Haensch half-shadow apparatus is is used.

The results of the analysis of the pulp are very exact and satisfactory, but those of the juice are less so, owing to the difficulty of pressing the pulp uniformly even when the detailed directions are carefully followed, but the result is sufficiently accurate for calculating the coefficient of purity. The percentage of sugar in the pulp is read off directly on the scale of the polarization apparatus, but the percentage of sugar in the juice is calculated, as in this case the normal weight of 26.048 grams in 100 c. c. was not taken but instead 50 c. c. in 100 c. c. The formula is 50 c.c. $\times$ specific gravity : 26.048 :: polarization : x; or grams of juice taken : normal weight :: polarization : x. Tables are used, of course, which show the per cent of sugar corresponding to various polarization and Brix readings.

By non-sugar is understood the per cent as shown by the saccharometer less the per cent of sugar in the juice.

The purity coefficient is found by multiplying the percentage of sugar in the juice by 100 and dividing the product by the per cent Brix.

ABSTRACTS OF PUBLICATIONS OF THE AGRICULTURAL EXPERIMENT STATIONS IN THE UNITED STATES.

BOTANY.

WALTER H. EVANS, *Editor.*

Natural distribution of roots in field soil, F. H. KING (*Wisconsin Sta. Report for 1892, pp. 112–120, figs. 9*).

Synopsis.—This is an account of methods used and results obtained in efforts to secure specimens for classroom use, illustrating (1) corn roots in natural position in a given section of soil between two rows, (2) total root distribution of corn from nine to twenty-seven days old, and (3) vertical distribution of roots of various plants in field soil, together with a discussion of data secured in observations on the total root development of oats, barley, corn, and clover, as compared with the crop produced.

The object of this investigation was primarily to secure "specimens illustrating the actual extent and manner of root penetration and development in field soils under normal conditions of tillage."

Distribution of corn roots in a given section of natural soil between two rows (pp. 112–114).—With a spade a trench 2 feet wide was dug so as to leave a prism of soil 1 foot thick and extending at right angles across two rows of corn; one hill of corn was thus left standing at each end of the prism. The trench was deepened until by inspection it was evident that all roots had been passed. A cage was now made of galvanized iron and wire netting, just large enough to set down over the prism of soil, and when this was in place sharpened wires were forced through the prism of soil in parallel lines along the meshes of the netting, the wires being long enough to reach through and fasten to the netting at each end. The loose soil at the surface of the ground was removed and replaced by casting in its place a block of plaster of paris to represent the surface of the ground. At this stage a force pump throwing a stream of water about one sixteenth of an inch in diameter was used to wash the soil away from the roots, leaving them suspended by the wires and held very nearly in the true relative positions they had occupied in the soil in which they grew. * * * The first sample was taken July 9, forty-two days after planting, when the tops had attained a height of about 18 inches. At this stage the roots of the two hills met and passed each other in the center of rows 3 feet 6 inches apart, and had penetrated to a depth of about 18 inches. It was found that the surface roots sloped gently downward toward the center of the row, where those nearest to the surface were some 8 inches deep. When the corn had attained a height of nearly 3 feet at the time of the last cultivation [a second] sample was taken. Here the roots are found to occupy the entire soil down to a depth of 2 feet, which is the height of the cage. At this stage the surface leaders descend in a gentle curve toward the center of the row, where they pass one another and lie only 6 inches deep.

Just as the corn was coming into full tassel a third sample was taken, and here it will be seen the roots have fully occupied the upper 3 feet of soil in the entire field. In the center of the row, too, the surface leaders have risen still higher, and a few of them are now scarcely 5 inches deep, though the great bulk of them are still 6 inches or more below the surface at the center.

When the corn had reached maturity one other sample was taken, and in this case a cage 4 feet deep was required, for the roots reached to and even beyond the bottom. At the center of the row, too, the surface leaders had risen to within 4 inches of the top of the ground. Nothing can illustrate more forcibly than these samples how deeply and how broadly this great American food plant is able to send its roots foraging through the soil. Not one half of the actual root surface which occupied the soil is shown in the engravings, because it was chiefly only the leaders or main trunk roots which were preserved in the sample. Each of these trunk roots or leaders sends out from opposite sides, much as the stalk does its leaves, slender rootlets from 2 to 6 inches long, and from the surface leaders these slender rootlets stretch directly upward toward, and nearly reaching the surface in the latter part of the season.

Total root distribution of corn from nine to twenty-seven days old (pp. 114–117).—The method used here was to have three series of circles, 18, 24, and 30 inches in diameter, across which was stretched galvanized wire netting with half-inch meshes. These circles were arranged so they could be strung upon three-quarter-inch iron rods and held 2 inches apart by means of spools. Holes were dug in the field of the desired size and depth, and in the bottom of each was placed one of the circles of each set. Upon these was then replaced 2 inches of the soil which had been removed, and well firmed. A second circle was then strung upon the rods and 2 inches more of soil added. In this manner the soil was replaced so as to have the circles lying in it each 2 inches apart. The upper circle was covered with about 2 inches of soil and in this the corn was planted directly above the center of the upper circle constituting each set.

At the end of nine days the dirt was removed from around the 18-inch cage and with the force pump, as already described, the soil washed away from the roots. At this stage it was found that some of the roots had extended laterally to a distance of 16 inches, and that some had reached a depth of 8 inches. No roots were found above the upper circle at a distance of 3 inches from the hill, and none above the second circle at a distance of 9 inches. The tips of the longest roots were 6 inches below the surface, and no roots were nearer the surface than 3 inches at 6 inches from the hill of corn.

Nine days later, that is, eighteen days from planting, the second cage was washed out. Here all roots had sunk below the top circle at a distance of 5 inches, and below the second circle at a distance of 18 inches. The tips of the longest roots had spread laterally to a distance of 18 inches, and were 5 or more inches below the surface. The longest roots extending downward had scarcely reached 12 inches. No roots were nearer the surface than 2 inches at 6 inches from the hill.

The roots of the remaining sample were washed out twenty-seven days after planting. Here all roots were below the upper circle at a distance of 3 inches from the center, and below the second circle at a distance of 16 inches. The greatest depth to which the roots had reached was 18 inches, and the longest roots extending sidewise had reached 24 inches from the hill, and their tips lay 4 inches below the surface. At 6 inches from the hill, no roots were nearer the surface than 2 inches.

The vertical distribution of roots in field soils (pp. 117, 118).—To procure samples illustrating the vertical distribution of roots in field soils the following method was used:

A galvanized-iron cylinder 12 inches in diameter and 4 feet long was provided, with a stiff outside collar at its upper end to enable it to retain its form while being driven, and an inside collar at the lower end so as to cut a core of soil a little smaller

than the cylinder. The sides of this cylinder were perforated with series of 1¼ inch holes, through which water could be forced with the pump to wash out the soil from the roots. In obtaining the sample the cylinder was driven down vertically into the soil with a sledge, by striking upon a heavy block of wood placed upon the top of the cylinder. After being forced into the ground in this manner to a depth of 6 to 8 inches, dirt was removed from around the cylinder to within an inch of its lower end, when it was forced down again; this was repeated until the cylinder was forced its full length into the ground, when it was lifted out, carrying all of the soil and roots with it. Two grain sacks were now drawn over the cylinder from opposite ends, and the whole immersed in the lake and left from 12 to 24 hours for the soil to soften, thus enabling it to wash out more readily, under the jet from the force pump.

In this manner samples were taken of blue grass, timothy, clover, winter wheat, barley, oats, and the English forage plant, *Lathyrus sylvestris*. * * * The blue grass has much the shortest roots, being only about 26 inches long, while in each of the other cases a length of nearly or quite 4 feet is attained.

The total root development of oats, barley, corn, and clover (pp. 118–120).—In connection with experiments to determine the amount of water required to produce 1 pound of dry matter in different crops, observations were made on the total root development associated with a given amount of top.

"The roots and tops of the duplicate specimens * * * were carefully separated and dried at 212° F. The amount of dry matter in the root calculated per acre, and the ratio of root to top are given below, the stubble, cut close to the ground, being included with the roots."

Dry matter in roots and tops of different plants.

	Dry matter per acre.		Ratio of top to root.		
	In tops.	In roots.	Tops.		Roots.
	Pounds.	*Pounds.*			
Oats	8,189.28	3,658.17	2.23	to	1
Barley	14,196.00	4,207.90	3.34	to	1
Clover	12,486.25	3,120.56	4.00	to	1

It may well be doubted whether the ratios here given will represent very closely those which would be found in natural field soils. However this may be, it must be very evident from all of the samples of roots illustrated in this report, that the aggregate amount of organic matter left in the soil by the crops here considered must be large.

METEOROLOGY.

W. H. BEAL, *Editor.*

Meteorological observations at the Massachusetts State Station (*Massachusetts State Sta. Bul. No. 50, Oct., 1893, p. 1*).—Notes on the weather and a summary of observations on temperature, precipitation, and prevailing wind for August and September, 1893, compared with similar data for the same months of 1892.

Meteorological observations at Massachusetts Hatch Station (*Massachusetts Hatch Sta. Met. Buls. Nos. 57, 58, and 59, Sept., Oct., and Nov., 1893, pp. 4 each*).—Daily and monthly summaries of observations for September, October, and November, 1893, at the meteorological observatory of the station.

Meteorological summary for North Carolina, September, 1893, H. B. BATTLE, C. F. VON HERRMANN, and R. NUNN (*North Carolina Sta. Bul. No. 93a, Oct. 15, 1893, pp. 18, maps 2*).—Notes on the weather and tabulated daily and monthly summaries of observations by the North Carolina Weather Service coöperating with the U. S. Weather Bureau.

WATER—SOILS.

W. H. BEAL, *Editor.*

Influence of barnyard manure on the movement and amount of water in soil, F. H. KING (*Wisconsin Sta. Report for 1892, pp. 106–111*).

Synopsis.—The results of experiments in the field and in galvanized iron cylinders confirm those obtained in previous years in showing that manure has a considerable influence in increasing the water content of the soil, even down to a depth of 4 feet, and that this influence is still exerted a year after manuring.

This is a continuation of experiments described in the Annual Report of the station for 1891 (E. S. R., vol. IV, p. 124). "The present season these experiments were repeated in essentially the same manner as last year, and upon similar ground, the one difference being that the plats were larger, and extended north and south in the direction of the slope of standing water in the ground, instead of east and west as they did the season before."

One plat received a heavy dressing of cow manure, which was plowed in to a depth of 5 inches, and two remained unmanured. The soil of each plat was frequently stirred, composite samples were taken to a depth of 4 feet, and moisture determined May 16 (before manuring), July 13, and August 30.

The tabulated results show that the water content remained very constant throughout the season.

The manure had the effect of changing the water content on the manured ground so as to make a relative increase in the manured soil of 0.97 per cent on July 13, and of 0.71 per cent on August 30; a difference of 3.7 pounds of water per square foot on the former date, and of 2.7 pounds on the latter for each column of soil 4 feet deep.

On April 11, soon after the frost was out of the ground, and before many of the spring rains had fallen, samples of the soil were taken in one-foot sections down to a depth of 6 feet on each of the four plats experimented with last year to ascertain if any difference in the water content of the soil was measurable at this time. The

result showed that the surface foot was still 0.57 per cent more moist than the unmanured ground, and that the whole column of soil 6 feet long had an average of 0.24 per cent more water than the unmanured soil did.

In the case of the manured and unmanured ground which produced corn the present year, the former yielded at the rate of 7,740.6—6,351=1,389.6 pound smore dry matter than did the latter, and yet the manured ground contained at the time of harvest to the acre in the upper 4 feet of soil only 74.78—74.47=0.31 pounds less water than the unmanured soil did for each column 4 feet long and 1 square foot in section. But if we suppose that the corn in the field consumed water at the mean rate observed for the corn grown in the cylinders, there should have been an observed difference in the water content of the field soil amounting to 10.08 pounds per square foot instead of the actual difference of 0.31 pounds. Here again, as was the case last year, it appears that there must have been 10.08—0.31=9.77 pounds of water brought up from the supply of permanent water in the ground unless, first, a pound of water on manured ground yields more dry matter than on unmanured ground, or second, unless the evaporation from the surface of the manured ground was less than that from the unmanured.

Experiments with manured and unmanured soil in galvanized iron cylinders showed that while there was a diminished evaporation from the manured cylinder it was "not quite half large enough to account for the increase in dry matter on the manured ground in the field, so that there still remains an effect of the manure in crop production unaccounted for by a difference in the rate of surface evaporation."

The influence of deep and shallow cultivation on the water content of the soil, F. H. KING (*Wisconsin Sta. Report for 1892, pp. 101–105*). — The experiments here reported are similar to those described in the Annual Report of the station for 1891 (E. S. R., vol. IV, p. 124). In the present case the changes in water content of tile-drained clay loam soil cultivated 1 and 3 inches deep were observed. Corn was the crop grown, every alternate three rows being cultivated shallow and the remainder deep. Determinations of the moisture content of the soil to a depth of 4 or 5 feet at time of planting and of harvesting are tabulated and discussed at some length. The results are summarized as follows:

(1) Thorough cultivation greatly diminishes surface evaporation from the soil.

(2) Thorough cultivation keeps the soil below the surface cooler and this materially strengthens the capillary power so that less water percolates downward out of the reach of root action.

(3) The capillary force being stronger the soil moisture is moved upward faster and through longer distances as the roots of growing crops consume it, and thus more water becomes available.

The amount of water required to produce a pound of dry matter in barley, oats, corn, clover, and peas in Wisconsin, F. H. KING (*Wisconsin Sta. Report for 1892, pp. 94–100*).

Synopsis.—In continuation of work of previous years, observations were made on corn grown in galvanized cylinders and in the field in natural conditions, and on other crops grown either in barrels or iron cylinders. The observed amounts of water consumed per pound of dry matter produced were as follows: Barley 375.21 pounds, oats 525.59 pounds, corn 316.9 pounds, clover 564.43 pounds, and peas 477.37 pounds.

"The experiments of this season were conducted on essentially the same plan as were those of last year" (Annual Report of the station for 1891; E. S. R., vol. IV, p. 126), except that galvanized iron cylinders 18 inches inside diameter and 40 inches deep were substituted for the vinegar barrels heretofore used in all experiments except those with clover. The cylinders "were weighed from time to time with a specially constructed weighmaster's beam, sensitive to one tenth of a pound when carrying a weight of 600 pounds." They were protected from excessive rainfall, and water was added as required to maintain about the same weight in each case as at seeding time "when the moisture was such as to give the soil good tilth. * * * The surface of the ground was stirred in the case of the corn, to correspond with the field conditions, but otherwise no effort was made to check the surface evaporation."

The following table gives the observed amounts of water required to produce one pound of dry matter in the different crops during 1891 and 1892:

Amount of water required to produce a pound of dry matter in different crops.

Crop.	Water required per pound of dry matter.	Computed yield per acre.	Computed amount of water used—	
			In tons per acre.	In inches.
	Pounds.	*Pounds.*		
Barley, 1891	401.74	7,441	1,494.67	13.19
Barley, 1892	375.21	14,196	2,663.89	23.52
Oats, 1891	501.47	8,861	2,221.76	19.69
Oats, 1892	525.59	8,189	2,152.11	19.00
Corn, 1891	301.49	19,845	2,991.53	26.39
Corn, 1892	316.90	19,184	2,842.37	25.09
Clover, 1892	564.43	12,486	3,367.84	29.73
Peas, 1892	477.37	8,017	1,913.48	16.89

The oats did not do quite as well in the cylinders as they did in the field, nor quite as well as they did in the barrels in 1891. The crop of barley was, however, much better both in the field and in the cylinders than it was the previous year.

* * * The [corn] plants in one cylinder did not do as well as did the corn in the field, the stalks being shorter and the ears smaller than the average for the field. In the other case the two stalks with their ears were fully up to the average from the field. * * *

It will be noted in the first place that the oat crop, when compared with the barley, used relatively much more water for a pound of dry matter produced both in 1891 and in 1892, the average of the three trials for oats being 513.52 pounds, while that for the barley was only 388.48, or 125 pounds of water less for a pound of dry matter in the case of barley than in the case of the oats, and since the yield of dry matter to the acre of oats is likely to be as great or even greater than with the barley, it is evident that the oat crop must exhaust the soil of moisture to a much greater extent than does that of barley, and there is good reason for believing that this difference explains in a large measure why seeding ground to clover is likely to be much more successful with barley than with oats.

It will be observed in the second place, that the corn crop, the great American staple, has during these trials consumed less water per pound of dry matter than either of the other crops, the average of the four cases being only 309.2 pounds, as

compared with 388.48 for barley, 477.37 for peas, 513.52 for oats, and 564.43 pounds of water for 1 pound of dry matter in clover. One of the chief reasons, in my judgment, for the relatively small consumption of water by corn is to be found in the fact that much less water is lost from the soil by direct surface evaporation on account of surface cultivation during so much of the growing season.

It is quite probable that the relatively large consumption of water by the clover shown by the single trial is more apparent than real, because it seems quite likely that the evaporation through the sides of the barrels during the second year's service may have been considerable.

As a check on these experiments observations were made on corn growing in the field under natural conditions. From determinations on manured and unmanured ground of the moisture content of the soil to a depth of 4 feet at seed time and harvest, the total rainfall during the season, and the amount of dry matter produced, it was found that "it must have required 404.6 pounds of water for a pound of dry matter on the unmanured and 333.7 pounds on the manured ground."

From tabulated data showing the relation between the amount of dry matter produced and the number of inches of water consumed by oats, barley, and corn, it appears—

That the yield of dry matter per acre for the three crops is measurably proportional to the number of inches of water consumed during their growth. Taking the cases of the crops grown in the cylinders, the nearly equal yields of corn and of oats in 1891 and 1892 are associated with nearly equal amounts of water used per unit area, but the smaller yields are associated with the smaller amount of water. In the case of the barley, where the yield in 1892 is nearly double that of 1891, the depth of water supplied was also nearly doubled. These results point very strongly toward the conclusion that we rarely have water enough in our soils under natural conditions to realize even approximate possible returns from our land, and that were we prepared to irrigate almost any of our crops at such time as there is a deficiency of water in the soil, very much larger average yields would be secured.

Fluctuations of the level and rate of movement of ground water, F. H. KING (*Wisconsin Sta. Report for 1892, pp. 129–218, figs. 37, plates 6*).—This is a reprint of Bulletin No. 5 of the U. S. Weather Bureau (E. S. R., vol. IV, p. 670).

FERTILIZERS.

W. H. BEAL, *Editor*.

Legislation relating to fertilizers in Connecticut (*Connecticut State Sta. Bul. No. 116, Oct., 1893, pp. 2–5*).—A copy of the State fertilizer law as amended by the general assembly in 1893, with comments.

Fertilizer inspection and analyses in Massachusetts (*Massachusetts State Sta. Bul. No. 50, Oct., 1893, pp. 2–6, 8*).—A schedule of trade values of fertilizing ingredients in raw materials and chemicals is given, together with tabulated analyses of 58 samples of fertil-

izing materials, including nitrate of soda, dissolved boneblack, muriate of potash, sulphate of potash, bone, ashes, and compound fertilizers.

Fertilizer inspection and analyses in New York (*New York State Sta. Bul. No. 59, n. ser., Sept., 1893, pp. 423–457*).—This bulletin includes a schedule of trade values of fertilizing ingredients in raw materials and chemicals and tabulated analyses of 212 samples of commercial fertilizers collected during the spring of 1893.

Cotton-seed meal as a fertilizer and feed (*Connecticut State Sta. Bul. No. 116, Oct., 1893, pp. 6–8*).—Descriptions and the nitrogen, potash, and phosphoric acid content of 13 samples are given. The results lead to the following recommendations: "In ordering meal to use as a food or as a fertilizer, purchasers should require decorticated upland cotton-seed meal, containing at least 6.5 per cent of nitrogen, unless they are willing to use the other greatly inferior meal, which can not be economically done unless it can be got for a greatly reduced price."

FIELD CROPS.

J. F. DUGGAR, *Editor.*

Effect on the yield of corn of different methods of harvesting the fodder, G. L. TELLER (*Arkansas Sta. Bul. No. 24, July, 1893, pp. 119–122*).

Synopsis.—The yield of grain was but slightly reduced by topping corn, but considerably reduced by stripping the leaves, and the loss of grain was still greater when the stalks were cut and shocked.

In 1892 one fourth of the stalks on an acre of early corn were stripped of the leaves, another fourth topped above the ear, another fourth cut and shocked, and the remaining stalks left in their natural condition. At the time of harvesting the fodder the bottom leaves of the plants were dying, and the kernels, nearly past the milk stage, were denting.

The following table shows the effect of the different treatments on the yield of shelled corn:

Effect of stripping, topping, and shocking on the yield of corn.

Method of treatment.	Yield per acre.	Yield per acre.	Loss per acre.
	Bushels.	*Pounds.*	*Pounds.*
Not treated	$22\frac{1}{7}$	1,241	....
Topped above the ear	$21\frac{5}{7}$	1,224	17
Leaves stripped	$19\frac{5}{7}$	1,102	138
Stalks cut and shocked	$19\frac{1}{5}$	1,075	166

The percentage of total and of albuminoid nitrogen was slightly less in the grain from the plants which were not treated.

The weight per acre of each kind of forage, calculated on a basis of 11 per cent water content, was as follows: Leaves, 443 pounds; tops, 438 pounds; whole fodder (stover) 1,776 pounds; uneaten butts, 295 pounds; and husks, 236 pounds.

The following table gives the composition of the dry matter in each kind of forage:

Composition of parts of the corn plant.

	Ash.	Crude protein.	Crude fat.	Crude fiber.	Nitrogen-free extract.	Total nitrogen.	Albuminoid nitrogen.	Amide nitrogen.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Leaves	10.76	10.97	2.80	20.77	54.70	1.76	1.58	0.18
Tops	8.39	7.77	1.83	26.20	55.81	1.24	1.05	0.19
Whole fodder	7.57	6.35	1.32	33.05	51.71	1.02	0.92	0.10
Uneaten butts	4.68	3.40	1.02	40.32	50.58	0.54	0.42	0.12
Husks	3.34	3.18	0.70	33.57	59.21	0.51	0.49	0.02

Changes in the composition and yield of the cowpea from flowering to maturity, G. L. TELLER (*Arkansas Sta. Bul. No. 24, July, 1893, pp. 122–144*).

Synopsis.—Tabulated data and a discussion of results obtained in analyses with reference to food and fertilizing ingredients of vines, seeds, hulls, stems, leaves, and roots of the cowpea at different stages of growth from August 7 to September 14 in a set of plat experiments, and from August 7 to October 25 in a set of box experiments. In the field experiments the greatest weights of dry matter, of crude protein, and of nitrogen-free extract per acre were found at the sixth cutting, September 8. In the roots and stubble there was more nitrogen at the third cutting, August 20, than at any other time.

In 1891 seven cuttings of cowpeas were made at intervals of six days during the period from August 7 to September 14. The variety was the Whippoorwill, planted June 13 with a wheat drill, in rows about 9 inches apart; the plants were afterwards thinned to 3 inches in the row, at which distance the stand was regarded as equivalent to that which would be secured by sowing broadcast 5½ pecks of seed per acre. At each cutting 3 one-thousandth-acre plats were taken. After careful air-drying in the laboratory the peas were separated from the straw and each part analyzed separately. At each cutting the roots were washed out on an area of 2 feet square to a depth of 3 feet. The growth on all the plats was not entirely uniform.

The dry vines cut August 20 contained 4.6 per cent of shelled peas; August 26, 9.6 per cent; September 2, 25.2 per cent; September 8, 27 per cent; and September 14, 37 per cent.

The following table gives the total amount of the different food constituents per acre in cowpea vines and seed on a basis of 11 per cent water for the vines and 12 per cent water for the seed :

Amount of food constituents per acre in cowpea seed and vines.

	Cut Aug. 7.	Cut Aug. 14.	Cut Aug. 20.	Cut Aug. 26.	Cut Sept. 2.	Cut Sept. 8.	Cut Sept. 14.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Water	193.7	231.6	203.0	315.2	340.9	349.0	308.0
Ash	188.9	210.8	230.4	209.5	181.7	180.8	135.1
Crude protein	302.3	330.6	382.9	424.7	407.4	414.2	386.3
Ether extract	38.1	48.0	53.2	65.7	65.2	64.3	50.8
Crude fiber	390.7	546.4	640.2	723.5	719.2	720.5	571.6
Nitrogen-free extract	647.3	738.6	810.3	1,100.9	1,315.6	1,367.7	1,258.6
Total harvest	1,761.0	2,106.0	2,381.0	2,839.4	3,029.0	3,096.5	2,710.4
Albuminoids	227.9	248.7	287.3	341.3	339.0	345.4	333.3
Amides	74.4	81.9	96.6	83.4	68.4	68.8	53.0

The greatest combined weight of peas and vines, and of nitrogen-free extract in these, was afforded by the cutting of September 8.

The nutritive ratios for pea straw and pea hay, cut at different dates, calculated by means of digestion coefficients found by the North Carolina Station, are given below:

Nutritive ratio of cowpea straw and hay cut at different dates.

	Cut Aug. 7.	Cut Aug. 14.	Cut Aug. 20.	Cut Aug. 26.	Cut Sept. 2.	Cut Sept. 8.	Cut Sept. 14.
Straw	1:3.4	1:3.8	1:3.8	1:4.6	1:6.6	1:6.9	1:7.5
Hay	1:3.4	1:3.8	1:3.7	1:4.2	1:5	1:5	1:4.8

The following table gives the composition and amounts per acre of the different parts of the cowpea plant; the plants examined were grown at a distance of 9 inches apart each way and were overripe when gathered:

Composition and amounts of nutrients per acre for the seeds, hulls, stems, and leaves of the cowpea.

	Composition.				Amounts per acre.			
	Peas.	Hulls.	Stems.	Leaves.	Peas.	Hulls.	Stems.	Leaves.
	Per ct.	*Per ct.*	*Per ct.*	*Per cent.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Water	....	....	....	....	81.6	30.2	59.7	11.6
Ash	3.46	3.28	6.35	11.63	20.7	7.3	27.8	9.9
Crude protein	25.71	4.60	6.87	18.40	153.9	10.2	30.0	15.6
Crude fat	1.45	0.51	0.98	7.85	8.7	1.1	4.3	6.7
Crude fiber	5.34	46.51	43.13	16.00	32.0	102.9	188.8	13.6
Nitrogen-free extract	64.04	45.10	42.67	46.12	383.2	99.8	186.8	39.2
Total	....	....	....	....	680.0	251.5	497.4	96.6
Nitrogen	4.11	0.73	1.10	2.94	....	....	....	....
Phosphoric acid	0.74	0.15	0.16	0.40	....	....	....	....
Potash	1.52	0.87	1.77	1.16	....	....	....	....

The results from collecting the roots on the plats being unsatisfactory, the following device was used to collect roots and other parts of the plant for analysis:

A pit was dug in the ground 4 feet deep. The bottom was hard clay. A four-inch tile drain was laid in the bottom of the pit. Thirty boxes were made by saw-

ing twelve-inch boards into lengths of 4 feet each and nailing together so as to give a soil area when filled of 10 by 12 inches. They were left open at both ends and set upright in the pit, in 3 rows of 10 boxes each. Dirt was then filled around the outside and a thin layer of clay tamped into the bottom of each. Each was then filled with the mixed and sifted surface soil of the surrounding land, which was a clay loam. The soil was well rammed during the filling and an effort was made to fill all alike. After being settled by a rainfall they were refilled, and the soil then settled but little more during the summer. The soil was planted with Whippoorwill peas, July 6, 1892, and three plants allowed to grow in each box.

A short row of 3 boxes was taken up on each day of harvesting. The second series of boxes was not taken up, but was moved beside those remaining after each gathering. For the first three dates the soil was washed from the roots as in the field during the previous year. This being again unsatisfactory, only the roots large enough to be picked from the soil with forceps and fingers were taken from the remaining boxes. The falling material was collected through the summer and weighed for each box separately. Those of each series were then mixed and the nitrogen determined. * * *

The plants of the ninth cutting were in the end boxes and made a more vigorous growth than did the others, and the results can not in many respects be compared with those from the others. * * * The plants of the last cutting will, for the most part, be ignored throughout the discussion.

Analyses of leaves, fallen matter, stems, pods and peas, hulled peas, roots, and entire plants, made at seven different dates from August 7 to October 25, are tabulated.

There is a decrease in the per cent of nitrogen, from beginning to end, in all parts except the fallen material. The greatest total weight of the nitrogen in the leaves was at the time of the third cutting. * * *

With the exception of the fifth cutting, the weight of dry matter in the stems increases slightly to the end, but the weight of the nitrogen in them decreases from the fourth cutting. * * *

There is an increase in the weight of the fallen matter from cutting to cutting as well as in the weight of the total nitrogen contained in it. * * *

The method of taking roots did not secure the finer freshly formed rootlets. In those parts secured there is a marked and steady decrease in both total dry matter and total nitrogen after the fifth cutting. This decrease is too regular to be considered purely accidental. * * *

When considering the weight of the total dry matter produced up to the time of each cutting, including the fallen matter and roots, a continuous increase is found throughout except for a slight falling off in the eighth cutting. The same is true of the total and the albuminoid nitrogen.

The following amounts of dry matter and nitrogen per acre found in the roots and stubble of cowpeas are based on the average of three determinations in each stage of growth except for the last two, in which only two determinations were made. The roots on an area of 2 feet square and to a depth of 3 feet were used, and the stubble included in the determinations was about 3 inches high:

Dry matter and nitrogen in roots and stubble of cowpeas.

	Cut Aug. 7.	Cut Aug. 14.	Cut Aug. 20.	Cut Aug. 26.	Cut Sept. 2.	Cut Sept. 8.	Cut Sept. 14.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Dry matter per acre	860	672	1,074	1,051	931	830	950
Nitrogen per acre	13.2	9.6	15.2	14.2	11.4	9	10.2

[With nitrogen at 10 cents, phosphoric acid at 5 cents, and potash at 4 cents per pound] there was retained in the soil, in the stubble and roots, nitrogen worth $1 per acre. At the time of the sixth cutting [Sept. 8], which is that of the greatest weight of hay, there was removed from the soil in the total produce of 1 acre 13 pounds of phosphoric acid, worth 65 cents, and 47 pounds of potash, worth $1.88, a total of $2.53. * * *

If [Sept. 8] the peas had been picked and the pods returned to the soil there would have been removed from the soil potash and phosphoric acid worth 83 cents, and there would have been retained to it in the straw and roots 45 pounds of nitrogen, worth $4.50 per acre. * * *

In each ton of hay taken at the sixth cutting there was 30.3 pounds of potash worth $1.21, 8.3 pounds phosphoric acid worth 42 cents, and 42.7 pounds of nitrogen worth $4.27, making a total of $5.90 worth of fertilizing ingredients. * * * In each dollar's worth of peas selling at $1 per bushel there are manurial elements which it would cost more than 30 cents to purchase.

Experiments with potatoes, E. A. POPENOE, S. C. MASON, and F. A. MARLATT (*Kansas Sta. Bul. No. 37, Dec., 1892, pp. 151–160, plates 3*).

Synopsis.—A record of experiments conducted in 1890, 1891, and 1892 to test the relative value for seed of tubers from the first crop and from the second crop. By early planting of early varieties seed potatoes were secured in July sufficiently matured to produce a second crop in the same season. The second crop was light, the tubers often small, but firm and of fine quality. Second crop potatoes kept until planting time, were sound, firm, and nearly free from sprouts, while the ordinary crop became badly sprouted and shriveled. In most cases second crop potatoes used as seed gave a larger yield than seed tubers from the first crop, the increase in 1890 and 1891 averaging 48½ per cent. From second crop seed potatoes the growth of tops was larger and the blooms more abundant. Second crop seed, allowed to become sprouted and soft before planting, yielded only 14 per cent more than ordinary seed potatoes. Flat culture and hill culture gave practically the same yield.

In 1889 sixteen varieties of early potatoes were planted, March 15 and April 24. Of those planted March 15 a part were dug July 11 and immediately planted. The following spring seed from the crops planted March 15 (lot 1), April 24 (lot 2), and July 11 (lot 3) was planted March 18. At the time of planting the tubers in lot 1 were shriveled and small, having sprouted badly; those in lot 2 were of good size and had sprouted moderately; and those in lot 3 (from seed planted as soon as dug) were firm and of moderate size, and none had sprouted.

Three pounds of seed potatoes of each lot were used. The tubers were cut into pieces containing three eyes and the pieces planted a foot apart in the rows.

The potatoes from the lot planted July 11 (lot 3) came up a few days later than the other lots, but the plants were much stronger and darker green, grew faster, and bore more blooms.

Lot 1 yielded 53.2 bushels; lot 2, 77.6 bushels; and lot 3, 97.5 bushels per acre. The latter gave a higher percentage of marketable tubers, and these were of a more uniform size.

July 24, 1890, seed from each variety in lot 3 was planted for a second crop. The season was favorable, and the product from 5 pounds of seed potatoes ranged from 15 to 32 pounds, the highest yield being at the

rate of 200 bushels per acre. The second crop kept much better than the spring crop.

April 8, 1891, second crop seed from each of eight varieties was planted in comparison with first crop seed of the same varieties. Plants from second crop seed were three to six days later in coming up, but rapidly outgrew the others and bloomed more heavily, giving June 19 an average height of tops of 21 inches, while plants from first crop seed were only 15 inches high. The tops of the former weighed 50 per cent more than those of the latter. The total yield of eight varieties, each occupying 100 feet of row, was, for first crop seed, 598.63 pounds; for second crop seed, 1,016.72 pounds.

In 1892 the planting was quite late—May 18—when even second crop seed was considerably sprouted. Differences in the growth of tops were less marked than in previous years. On the basis of total yield, the results were inconclusive, some varieties giving a larger yield from first crop seed, others from second crop seed. The product from second crop seed was of better size and quality.

The average gain of the crop from second crop seed over that from spring crop seed was 27 per cent in 1890 and 70 per cent in 1891, or an average of 48.5 per cent for the two years. With some varieties the gain was more than 100 per cent. The average gain from using second crop seed in 1892 was only 14 per cent. The better results from seed of the second crop were considered due to the fact that this seed had not sprouted in storage.

In 1889, when about seven and one half months elapsed between the planting of the first crop and the digging of the second, frosts interfered somewhat with both. In 1891 a growing season of only six and one half months proved too short for a successful crop.

Experiments were made in 1891 and 1892 with seed potatoes from the main crop and from the second crop to determine at what age potatoes to be used as seed for the second crop should be dug, and whether these should be planted at once or exposed to light and air for a longer or shorter time before planting. In 1891 potatoes dug from seventy-two to ninety-nine days after planting were planted either at once or seven or twenty days thereafter. The only good stand secured was from tubers dug seventy-two days after the spring planting and planted twenty days later.

In 1892 lots dug after seventy-nine, one hundred and two, and one hundred and thirteen days were planted one hundred and thirteen days after the first planting, and a lot dug after one hundred and fourteen days was planted immediately. The lot dug after one hundred and thirteen days and planted immediately gave the largest yield in the majority of cases, but not uniformly. The results were not conclusive.

In a comparison in 1891 of high ridge and flat cultivation for potatoes, each of eight plats of College Seedling No. 2 received uniform treatment up to the time of the second cultivation, when half of the plats were given

high ridge cultivation for the rest of the season and the others were cultivated flat. The yield per acre was 166.74 bushels from hilling and 169.39 bushels from flat cultivation.

Potatoes, R. H. McDowell (*Nevada Sta. Bul. No. 20, Mar., 1893, pp. 3–14, figs. 4*).—Tabulated statements of the results of experiments made on small plats at the station in 1892. The experiments included planting pieces of different sizes, planting at different dates and at different depths, and variety tests. The crop increased as the size of the pieces planted increased. May 20 proved a better date for planting than May 30, June 15, July 1, or July 11. A small area planted December 15, 1891, made a good growth and afforded tubers which were in good condition when harvested. The yields of sixty-six varieties are tabulated, and the answers made by farmers to a circular letter on potato culture are given.

Experiments in potato culture, E. S. Goff (*Wisconsin Sta. Report for 1892, pp. 278–283*).

Synopsis.—The crop from seed potatoes badly affected with scab was lighter and of poorer quality than that from seed nearly free from scab. Flowers of sulphur applied to the seed slightly reduced the amount of scab. Removal of the seed or distal end of each potato slightly decreased the yield.

Scabby vs. clean seed (pp. 278–279).—On alternate rows were planted scabby seed and tubers nearly or quite free from scab. The total yield from scabby seed was 199⅝ pounds, from clean seed 477¾ pounds. From scabby seed 19.35 per cent of the crop was free from scab, 51.08 per cent slightly scabby, and 29.57 per cent badly scabbed; from clean seed 26.7 per cent of the crop was free from scab, 56.81 per cent slightly scabby, and 16.49 per cent badly scabbed. Clean seed germinated better than scabby seed, to which fact is probably due in part the large difference in yield.

Effect of sulphur on scab (pp. 280–281).—One half of the hills in each row were treated with sulphur, leaving the other half without treatment as a check. The sulphur was tried in two slightly different methods. In one the seed was dipped in water and then rolled in flowers of sulphur; in the other the seed was first dropped and then before covering it half a teaspoonful of flowers of sulphur was sprinkled over the seed and upon the soil about it over a circle of six inches in diameter. The tubers of the crop were assorted into three qualities. The results of this assortment appear in the following table:

Effects of using sulphur to prevent potato scab.

	Treated with sulphur.			Not treated.		
	Free from scab.	Slightly scabby.	Badly scabbed.	Free from scab.	Slightly scabby.	Badly scabbed.
	Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Seed tubers wet and rolled in sulphur	77.74	17.5	4.76	64.09	25.58	10.33
Sulphur sprinkled over seed tuber and upon the soil about it	57.53	28.82	13.45	51.30	31.49	17.21

"The figures indicate that the sulphur proved in some degree beneficial in reducing the amount of scab, but that it was far from being a complete remedy."

Effect of removing the seed end of seed potatoes (pp. 281–283).—This is a continuation of an experiment begun in 1889 and published in Bulletin No. 22 and the Annual Reports of the station for 1890 and 1891 (E. S. R., vol. II. p. 30; IV, p. 141). The averages of four years' experiments are given in the following table:

Effect of removing the seed end of seed potatoes.

Year.	Yield from entire seed.		Yield from seed with seed end removed.		Difference in favor of entire seed.	
	Merchantable.	Small.	Merchantable.	Small.	Merchantable only.	Total yield.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds*
1889	132.1	117.4	97.7	120.7	34.4	31.1
1890	1,813.25	693.75	1,744	679	69.5	84
1891	1,399.75	239.25	1,367.25	248.75	32.5	23
1892	240.25	67.25	220.5	80.25	20.25	7.25
	3,585.85	1,117.65	3,429.45	1,128.7	156.4	145.35

It thus appears that in each of the four seasons during which the trial has been conducted the entire seed has given the larger yield, the difference amounting on the average to something more than 4½ per cent. In but one of the four seasons did the yield of small tubers from the entire seed equal that from the seed having the seed end removed.

Sugar beet experiments in Wisconsin during 1891 and 1892, F. W. WOLL (*Wisconsin Sta. Report for 1892, pp. 290–213*).—A record of the results for 1891 was published in Bulletin No. 30 of the station (E. S. R., vol. III, p. 808). In 1892 on the station farm 5 varieties or strains of sugar beets were grown on about two-thirds of an acre of light clay loam. The yield was at the rate of 22,620 pounds of washed beets per acre. Estimating the cost of labor of a man at 10 cents per hour, man and horse at 15 cents, and man and team at 25 cents, the cost of growing and harvesting beets amounted to $3.64 per ton.

The amount of sugar produced by two strains of Vilmorin Improved is estimated at 2,251 and 3,410 pounds per acre; by Klein Wanzleben, 3,313 pounds; by Deprez Richest, 4,016 pounds; by White Imperial, 3,313 pounds. The average yield of sugar for three years is estimated at 3,821 pounds per acre.

A plat which was subsoiled yielded 20,040 pounds of washed beets per acre, with 15.13 per cent sugar in the juice and a purity coefficient of 82.2; a plat plowed 6 inches deep but not subsoiled yielded 19,380 pounds of washed beets per acre, with 15.76 per cent of sugar in the juice, and a purity coefficient of 83.7.

The results of a germination test with seed of 5 varieties or strains are tabulated, as are also meteorological data for the seasons of 1891 and 1892.

In 1892, 62 farmers sent samples of beets to the station for analysis,

The average percentage of sugar in the juice of these beets was 14.34, and the average yield of beets 38,545 pounds.

Tobacco, R. H. McDowell (*Nevada Sta. Bul. No. 20, Mar., 1893, pp. 15–31*).—A report of progress giving brief notes on sowing tobacco seed, irrigating, and curing tobacco. Tabulated data showing the yields of 12 varieties grown on small plats are given. Bulletin No. 19 of Georgia Station (E. S. R., vol. IV, p. 648) and Bulletin No. 44 of Alabama College Station (E. S. R., vol. V, p. 47) are quoted at length.

Tests of varieties of wheat, D. O. Nourse (*Virginia Sta. Bul. No. 28, May, 1893, pp. 75–79*).—Notes and tabulated data for 17 varieties tested at the station during three years. In 1893 Richelle de Napels was partly winterkilled and Rieti entirely. Small patches of rust appeared on every variety, but affected seriously only the two above mentioned. The tabulated results show the average yields of straw per acre for two years and of grain for three years. The largest yields of grain were by the Valley, Tasmanian Red, Fulcaster, Tuscan Island, and Red Fultz, in the order named, the yield per acre ranging from 24 to 22 bushels.

Wheat, effect of fertilizers, D. O. Nourse (*Virginia Sta. Bul. No. 29, June, 1893, pp. 83–85*).—Dissolved boneblack 142.5 pounds, muriate of potash 50 pounds, and nitrate of soda 124 pounds per acre, were applied singly, combined two by two, and all three together. Each of these materials was also applied in one half and in one and one half times the above mentioned amounts in connection with full amounts of the other two materials. An application of gypsum was made on one plat and another was unfertilized. The yields of grain and straw are tabulated. The results differed from those secured in the preceding year. The following table gives the yields for 1892 and 1893 and the average results for the two years:

Effect of fertilizers on the yield of wheat.

Treatment of plats.	1892.		1893.		Average for 2 years.	
	Grain per acre.	Straw per acre.	Grain per acre.	Straw per acre.	Grain per acre.	Straw per acre.
	Bushels.	*Pounds.*	*Bushels.*	*Pounds.*	*Bushels.*	*Pounds.*
Unfertilized	11.06	1,357	16.83	1,420	13.95	1,389
1 potash (50 pounds muriate)	11.00	908	16.08	1,315	13.54	1,112
1 phosphoric acid (142½ pounds boneblack)	11.15	1,170	18.17	1,610	14.66	1,390
1 nitrogen (240 pounds nitrate of soda)	8.75	1,115	14.97	1,673	11.88	1,394
Gypsum	7.42	965	13.33	1,330	10.38	1,198
1 potash, 1 phosphoric acid	13.66	1,290	19.42	1,665	16.54	1,478
1 potash, 1 nitrogen	11.96	1,543	18.25	2,265	15.11	1,904
1 phosphoric acid, 1 nitrogen	17.86	2,048	26.00	2,560	21.93	2,304
1 potash, 1 phosphoric acid, 1 nitrogen	17.71	2,178	25.42	2,250	19.75	2,214
½ potash, 1 phosphoric acid, 1 nitrogen	16.45	1,923	25.83	2,580	21.14	2,252
1 potash, ½ phosphoric acid, 1 nitrogen	15.25	1,975	24.33	2,260	19.79	2,118
1 potash, 1 phosphoric acid, ½ nitrogen	17.50	1,990	29.83	2,430	23.67	2,210
1½ potash, 1 phosphoric acid, 1 nitrogen	18.46	1,853	27.50	2,340	22.98	2,097
1 potash, 1½ phosphoric acid, 1 nitrogen	19.58	1,935	25.17	2,350	22.38	2,143
1 potash, 1 phosphoric acid, 1½ nitrogen	16.83	1,900	26.17	2,280	21.50	2,090

"From these two years' results it would seem profitable to apply not more than the one half ration of potash, one half of the nitrogen, and one of the phosphoric acid."

HORTICULTURE.

The culture of orchard and garden fruits, W. F. MASSEY (*North Carolina Sta. Bul. No. 92, Aug., 1893, pp. 1–63, figs. 23*).—A popular bulletin on fruit trees and small fruits, embracing brief notes on the life history of horticultural plants, methods of propagating fruit trees, directions for the culture of fruit trees and small fruits, and lists of standard varieties of apples, pears, quinces, peaches, plums, cherries, Japanese persimmons, pomegranates, figs, grapes, strawberries, raspberries, blackberries, dewberries, watermelons, and cantaloupes. Special lists of varieties suited for the different sections of North Carolina are given, and a chapter on the preservation of fruits gives directions for packing and shipping, drying, evaporating, canning, and preserving fruits. The various methods of grafting fruits and of training grape vines are illustrated by figures.

Strawberries, E. S. GOFF (*Wisconsin Sta. Report for 1892, pp. 284–289*).

Synopsis.—An experiment to ascertain the relative hardiness and productiveness of plants with ancestry free from disease and not weakened by bearing, and of plants with ancestry diseased or weakened by bearing. The former were more productive and much hardier. Notes on twenty-one varieties are given.

A strawberry grower whose custom it was to take his plants for setting from beds set the preceding spring, and which had not borne a crop of fruit, sent 50 such plants to the station in the spring of 1889. Two beds, about 4 rods apart, were set with these Wilson plants. From some unknown cause one bed in 1890 and 1891 was badly affected with blight; the other bed was nearly or quite exempt in both seasons.

In the spring of 1891 a bed of 65 young plants was made, the plants being taken from a bed set the previous spring, and which had been set in the spring of 1890 from the healthy bed grown from plants set in 1889. In other words, the ancestors of these 65 plants had been free from disease and had not borne a crop * * * for many years previous. This bed contained, in the spring of 1892, 332 strong plants, besides some others that had suffered from the winter, or a fraction over five and one tenth plants to each one set. * * * Twenty-six young plants from the blighted bed above mentioned were set in the spring of 1891 in two short rows adjoining the 65 plants just mentioned. The vigor of this blighted bed had become so much reduced that a larger number of young plants could not be obtained; these 26 plants are, therefore, from parents blighted severely for two generations, and yielding a crop of fruit the summer previous. But 43 plants have survived the winter from this bed, or a little less than one and seven tenths plants to each one set last spring. * * *

Plants with ancestry nearly free from disease, but having borne one crop of fruit, [gavé] four surviving plants for each plant set.

The plants from diseased ancestry yielded less fruit than those of parentage free from disease. The time of ripening and other characteristics of 21 varieties are given in notes.

WEEDS.

WALTER H. EVANS, *Editor.*

Nevada weeds, F. H. HILLMAN (*Nevada Sta. Bul. No. 21, Sept., 1893, pp. 15, figs. 4*).—Descriptions of the following common weeds are given: Common pigweed or rough amaranth (*Amarantus retroflexus*), common pigweed (*A. chlorostachys*), low amaranth (*A. blitoides*), white pigweed or tumble weed (*A. albus*), goose-foot, pigweed or lamb's quarters (*Chenopodium album*), knot-weed, knot-grass, or door-weed (*Polygonum aviculare*), curled dock or red dock (*Rumex crispus*), and common mullein or velvet-leaf (*Verbascum thapsus*). In addition to the descriptions, mounted samples of the seed and portions of the plant are given. The first four species are illustrated by photo-engravings. The present bulletin is the first of a series upon Nevada weeds to be arranged in a similar manner.

DISEASES OF PLANTS.

WALTER H. EVANS, *Editor.*

Preliminary report on rusts of grain, A. S. HITCHCOCK and M. A. CARLETON (*Kansas Sta. Bul. No. 38, March, 1893, pp. 14, plates 3*).—The life histories of *Puccinia graminis* and its allied species *P. rubigo-vera* and *P. coronata* are given, together with detailed notes on unsuccessful experiments with eight fungicides for the prevention of rusts. Experiments were performed testing the ability of the uredospores of *Puccinia graminis* to germinate in the presence of about thirty chemical compounds of various strengths. Most of them had no fungicidal value in ordinary strengths, and in solutions of 1 to 1,000 only mercuric chloride, copper acetate, potassium bichromate, potassium cyanide, acetic acid, and sulphuric acid prevented germination. Observations seem to show that the mycelium of the fungus winters in the tissues of the host.

The diseases affecting fruit trees and plants, with remedies for their repression, G. MCCARTHY (*North Carolina Sta. Bul. No. 92, Aug., 1893, pp. 65–144, figs. 24*).—A general statement is given regarding the nature of fungus and other enemies of fruit trees, shrubs, and vines, formulas and directions for the preparation and application of fungicides, descriptions and illustrations of spraying apparatus, and illustrated notes on the more common diseases of the orchard and vineyard. The following diseases are described, most of them illustrated, and remedies suggested: Diseases of the apple—leaf rust, scab, bitter rot, and fire blight; pear diseases—fire blight, leaf blight, and scab;

quince diseases—blight and scab; peach diseases—yellows, brown rot, leaf curl, and shot-hole disease; plum diseases—black knot, plum pockets, shot-hole disease, brown rot, leaf rust or blight, and rosette; cherry diseases—leaf spot, mildew, and brown rot; persimmon diseases—shot-hole disease, fruit rot, and root rot; fig diseases—yellow and red rusts; grape diseases—black rot, downy mildew, powdery mildew, anthracnose, leaf blight, and root rot or pourridié; blackberry and raspberry diseases—anthracnose, red rust, and leaf spot; a gooseberry and currant disease—powdery mildew; and a strawberry disease—rust or leaf blight.

Report of work in vegetable pathology, E. S. GOFF (*Wisconsin Sta. Report for 1892, pp. 264–277, figs. 5*).—The report consists of summaries of previous publications as follows: Experimental treatment for apple scab, published in Bulletin No. 3, Division of Vegetable Pathology, U. S. Department of Agriculture (E. S. R., vol. IV, p. 500); negative experiments continued from 1891 on the treatment for aphis, Annual Report of the station for 1891 (E. S. R., vol. IV, p. 173); and treatment for fungus diseases, Bulletin No. 34 (E. S. R., vol. IV, p. 729).

ENTOMOLOGY.

Insects affecting fruit trees and plants, with remedies for their repression, G. MCCARTHY (*North Carolina Sta. Bul. No. 92, Aug., 1893, pp. 65–144, figs. 45*).—An introductory statement regarding noxious insects, formulas and directions for the preparation and use of insecticides, illustrations and descriptions of spraying apparatus, and illustrated notes on the more common and destructive insects affecting fruit trees and plants, are given. The following insect pests are popularly described, most of them figured, and remedies for their repression suggested: Insects affecting the apple—codling moth or apple worm, curculio, canker worms, apple-tree tent caterpillar, tussock moth, woolly or root louse, round-headed borer, flat-headed borer, oyster-shell bark louse, and scurfy bark louse; pear insects—twig girdler, pear-tree psylla or hopper, blister mite, grasshoppers or locusts, and bag worm; quince insects—same as pear, excepting twig girdler; peach insects—root borer, curculio, June beetle, rose beetle, aphides, and periodical cicada; plum insects—curculio, root borer, and aphides; cherry pests—aphides, June beetle, and dog-day cicada; persimmon pests—aphides and royal walnut moth; fig pests—fig beetle and June beetle; grape insect pests—thrips or leaf hoppers, phylloxera, cane borer, root borer, leaf caterpillar, flea beetle, leaf roller and grape curculio; blackberry and raspberry pests—cane borer, root borer, snowy cricket, and sawfly; gooseberry and currant insects—imported currant

worm or sawfly and red spider; and strawberry pests—crown borer, root borer, and flea beetle.

The following beneficial or predaceous insects are figured and briefly described: Lady bugs, murky ground beetle, fiery ground beetle, green ground beetle, long ground beetle, tiger beetle, soldier bugs, lacewings, wheel bugs or devil's horses, and dragon flies.

FOODS—ANIMAL PRODUCTION.

E. W. ALLEN, *Editor.*

Corn stalks and straw as hay substitutes, E. B. VOORHEES (*New Jersey Stas. Bul. No. 96, Oct. 14, 1893, pp. 12*).—This is a popular bulletin intended to answer the following questions:

"(1) What fodders can be substituted for hay in order that the maximum amount may be sold?

"(2) How can hay be utilized in order that minimum quantities need be bought?

"(3) What feeds shall be bought in order to best utilize coarse fodder so as to retain present herds without loss?"

The bulletin gives information on the object of feeding, hay substitutes, feeding stuffs to be used with hay substitutes, the reliability of commercial feeding stuffs, current prices of feeding stuffs, and the preparation of rations, together with formulas for nine rations for dairy cows, six for horses, and three for fattening steers. In these rations the coarse fodder consists principally of corn stalks, corn fodder, straw, and clover hay.

Analyses of feeding stuffs (*Massachusetts State Sta. Bul. No. 50, Oct., 1893, pp. 6, 7*).—Analyses with reference to food and fertilizing constituents of wheat bran, wheat middlings, rice bran, and cooked feed are tabulated.

Composition of feeding stuffs, F. W. WOLL (*Wisconsin Sta. Report for 1892, pp. 314–325*).—This is a popular article on the composition of feeding stuffs, the use of feeding standards, etc., with a colored plate showing the relative amounts of water and digestible nutrients in 100 pounds of a large number of common feeding stuffs, and in milk, butter, and cheese.

The rational use of feeding stuffs, C. F. VANDERFORD (*Tennessee Sta. Bul., vol. VI, No. 2, Apr., 1893, pp. 31–43*).—This is a popular discussion of the scientific principles of feeding animals, composition of feeding stuffs, feeding standards, and the manurial value of feeding stuffs, with a table showing the fertilizing ingredients and their value per ton for a large number of fodder crops and commercial feeding stuffs.

Analyses of some different grades of hay from the Memphis (Tennessee) market, G. L. TELLER (*Arkansas Sta. Bul. No. 24, July, 1893, pp. 117–119*).—Analyses of Arkansas prairie hay, choice timothy, timothy No. 1, clover hay, and pea-vine hay, with rules for grading hay and prices of the different grades in the Memphis market.

Explanation of terms used in fodder analysis, G. L. TELLER (*Arkansas Sta. Bul. No. 24, July, 1893, pp. 111–117*).—A popular explanation of terms used in reporting analyses of feeding stuffs, with remarks on digestibility, nutritive ratio, etc.

On the economy of ensiling Indian corn, ears and all, F. W. WOLL (*Wisconsin Sta. Report for 1892, pp. 53–71*).

Synopsis.—This is a comparison on 16 milch cows of feeding corn ensiled, ears and all, with feeding ensiled corn stover and the ear corn from the same. There were two periods, one of six and the other of seven weeks, with a transition period of one week. One half the cows were fed whole silage the first period and changed to stover silage the second period, and *vice versa.* All received the same grain ration. The amounts of milk and of fat produced per 100 pounds of dry matter eaten were practically the same for the two kinds of silage, but considering the extra cost of picking off the ears and storing them apart from the stover the advantage was in favor of ensiling the stalks and ears together.

In September, 1891, four compartments of a silo were filled with Pride of the North corn, two pits being filled with corn with the ears on and two others with corn from which the ears had been picked. The corn was all run through a feed cutter before placing in the silo. "The losses were considerable, owing to the small size of the silo. The losses of dry matter were 15.8 per cent in case of the silage with ears and 24.2 per cent in case of the silage with no ears." The ear corn was left for a time in the field and afterward placed in the corn crib. By ensiling ears and all 19,950 pounds of dry matter were obtained in the silage, and by preserving the stover and corn separately 18,606 pounds of dry matter were secured. "This means a loss of nearly 7 per cent which was suffered by handling the corn crop separately instead of putting it into the silo, ears and all."

The feeding value of the whole corn silage in comparison with that of the stover silage and the ear corn was tested in an experiment with milch cows. Sixteen cows of the station herd were divided into two lots. In the first period one lot received the whole corn silage, and the other lot the stover silage and the dry ear corn, and in the second period the lots were reversed. The two kinds of food were fed *ad libitum.* "Owing to the large loss of corn passing through the cows fed whole corn, this was ground, husks and all, after the second week of both periods." In addition both lots received 3 pounds of ground oats, 2 pounds of shorts, and 4 pounds of hay per head daily. The feeding lasted from December 28, 1891, to March 28, 1892. The first period covered seven weeks and the second period six weeks, with an intermediate period of one week.

The fat content of the morning and evening milk of each cow was tested by the Babcock test during the first, fourth, and seventh weeks of period 1, and during the first, third, and sixth weeks of period 2. The cows and the water they drank were weighed daily during the weeks when the milk was analyzed. The data for the experiment show that 411.6 pounds more milk was produced on whole silage than on stover silage and ear corn.

Summarizing the result of the feeding experiment we have, briefly:

Thirty-three thousand seven hundred and fifty pounds of silage with ears in it, fed in addition to hay and grain feed (the feed containing 17,127.5 pounds dry matter in all), produced 11,835 pounds of milk.

Twenty-seven thousand five hundred and seventy-one pounds of silage with ears picked off, plus 4,341 pounds of dry ear corn, in addition to hay and grain feed as before (the feed containing 16,491.7 pounds of dry matter in all), produced 11,423 pounds of milk.

For the six weeks in which the milk was analyzed, we have the following data:

One thousand five hundred and sixty pounds of silage with ears in it, in addition to hay and grain feed (the feed containing 8,046.1 pounds dry matter in all), produced 5,547.3 pounds of milk, containing 255.8 pounds of fat.

Twelve thousand eight hundred and eighty-nine pounds of silage with ears picked off, plus 1,953 pounds of dry ear corn, in addition to hay and grain feed as before (the feed containing 7,783 pounds dry matter in all) produced 5,319.1 pounds of milk, containing 293·3 pounds of fat. * * *

One hundred parts of dry matter produced:

In whole corn silage ration, 68.9 pounds of milk and 3.18 pounds of fat; in stover silage and dry corn ration, 68.3 pounds of milk and 3.08 pounds of fat; difference in favor of ensiled corn, 0.6 pound of milk and 0.10 pound of fat, or 0.9 per cent and 3.2 per cent. * * *

While the data that go to make up these results are very numerous and obtained from 16 animals fed during three months, it would not do to generalize from this single experiment. It is plain, however, that the difference in the efficacy of the food materials in the two rations is not in favor of those of the dried corn ration. * * *

[From a financial point of view] it is evident that the farmer siloing his corn "ears and all" has the advantage of it, as, besides procuring the feed at less expense, he will get at least as much out of his corn when it is put into the silo as when it is dried and fed separately. While the work of siloing the corn with ears in it was two fifths more than that of siloing the stalks and leaves, in the latter case the expense of picking off the ears and taking care of the corn afterwards must be added to the cost.

Winter dairying in Tennessee, C. F. VANDERFORD (*Tennessee Sta. Bul. vol. VI, No. 2, Apr., 1893, pp. 44–60*).

Synopsis.—An experiment with two lots of 6 cows each in substituting cotton-seed hulls for a ration of corn silage and hay. The trial lasted three and a half months. Thirteen pounds of hulls were found to be equivalent to a ration of 15 pounds of silage and 6 pounds of hay and to cost about 10 per cent less. The continued use of cotton-seed hulls and cotton-seed meal with no other food was found to be unsafe.

An experiment is reported in substituting cotton-seed hulls for corn silage and hay in a ration for milch cows. Twelve cows of the station herd were divided into two lots of 6 each. The trial lasted from Decem-

ber 15 to March 29. At the beginning of the trial, lot A was fed 30 pounds of corn silage, 6 pounds of hay, 3 pounds of cotton-seed meal, and 5 pounds of wheat bran; and lot B was fed 25 pounds of cotton-seed hulls, 4 pounds of cotton-seed meal, and 4 pounds of corn meal. After a few weeks feeding in this way cotton-seed hulls were gradually substituted for the corn silage and hay in the case of lot A, and corn silage and hay were gradually substituted for the cotton-seed hulls in the ration of lot B. Finally the grain ration was also changed so that lot A received the ration throughout which lot B had been fed, and *vice versa.* In the last period of twenty days both lots were brought back to a uniform ration of 15 pounds of corn silage, 13 pounds of cotton-seed hulls, 3 pounds of cotton-seed meal, and 5 pounds of wheat bran. Full data for the experiment are tabulated for each animal. Most of the cows ate the ration of hay and silage more eagerly than the cotton-seed hulls.

It was found that the ration of cotton-seed products fed alone, i. e., cotton-seed hulls and cotton-seed meal, could not long be safely continued.

> The result shows that 13 pounds of cotton-seed hulls can be advantageously used to take the place of 15 pounds of corn silage and 6 pounds of hay in making up a ration with 3 pounds of cotton-seed meal and 5 pounds of wheat bran, while reducing the cost about 10 per cent. * * *
>
> We are thoroughly convinced that, properly used, cotton-seed hulls, from sound seed and free of extraneous matter, of such quality as those furnished to us for this series of experiments, are a valuable addition to our list of feed stuffs for milch cows. We can recommend as giving satisfactory results the use of as much as 15 pounds of cotton-seed hulls in the daily ration per 1,000 pounds live weight. A larger proportion has, with our cows, caused a weakening of the digestive powers, evidenced in some cases by a tendency to diarrhea, in others to constipation. * * *
>
> Cotton-seed meal is the most valuable of all the so-called waste products used as feed stuffs. It can be safely fed for long periods, as much as 5 pounds per day per 1,000 pounds live weight, in the ration for cows giving milk. For butter-making it is not advisable to exceed 3 pounds daily. As the cow approaches the time for calving, the proportion of cotton-seed meal should not exceed 3 pounds daily. * * *
>
> Cotton-seed meal and cotton-seed hulls should be far more extensively used as cattle food. These products of the cotton fields of the South will enable the farmers of Tennessee to maintain or to restore the fertility of their lands at the least cost for manures.

The article concludes with a popular discussion on the feeding value and economy of various commercial and grain feeds.

Rations for dairy cows, F. W. WOLL (*Wisconsin Sta. Report for 1892, pp. 72–93*).—A reprint of Bulletin No. 33 of the station (E. S. R., vol. IV, p. 740).

Cotton-seed meal compared with linseed meal for feeding lambs, J. A. CRAIG (*Wisconsin Sta. Report for 1892, pp. 21–23*).—A reprint from Bulletin No. 32 of the station (E. S. R., vol. IV, p. 261).

Feeding grain to lambs before weaning, J. A. CRAIG (*Wisconsin Sta. Report for 1892, pp. 9–20*).—A reprint from Bulletin No. 32 of the station (E. S. R., vol. IV, p. 260).

Feeding and marketing lambs, J. A. CRAIG (*Wisconsin Sta. Report for 1892, pp. 29–41*).

Synopsis.—A comparison of feeding grain to lambs previous to weaning, after weaning, and during fattening only. Before weaning and for nineteen weeks after weaning, the lambs fed grain gained considerably more than those without grain. In the last period, when all received grain alike, the lot which had received no grain in the first two periods gained slightly more than the other lot, but the lot receiving grain continuously was still ahead This lot produced more wool, and from a financial point the feeding of grain continuously was more profitable.

The experiment was divided into three periods, viz, about two months before weaning, about four and a half months after weaning, and about three months of fattening. It was the plan to carry the same lambs through all the periods, but it was found necessary to change some of them at the conclusion of the first and second periods.

In the first period 6 high-grade Shropshire ewes with 6 lambs were divided into two lots, the ewes of both lots being on pasturage, and the lambs of one lot receiving grain, while those of the other lot received no grain. The lambs were from twenty to twenty-five days old at the beginning of the period.

The three lambs that were fed grain before being weaned made 25 pounds more gain during the period of ten weeks than those that were not fed grain. The grain-fed lambs during that time ate 80 pounds of grain mixture, consisting of 1 part bran, 1 part corn meal, and ½ part oil meal, and costing in all 56 cents. At the end of the period an estimate of the comparative cost of the two lots and their market value shows that the three grain-fed lambs in lot 1 gave a profit of $1.49 more than those that had not received grain.

In the second period two lambs were added to each lot. The lambs were all given excellent pasturage, and, as before, one lot received grain and the other no grain.

The five lambs that were fed grain, gained 104 pounds more than those that did not receive any grain. They ate 915 pounds of grain, consisting of 2 parts ground corn, and 1 part oil meal, at a cost of $7.38; and this, added to the cost of the previous period, makes the total cost to the end of the second period $8.31. At the end of this period an estimate of the comparative cost of the two lots shows that the 5 grain-fed lambs in lot 1 gave a profit of $2.14 more than those that had not received grain.

In the third or fattening period one lamb was dropped from each lot, and both lots were fed the same food, the object being to observe the effect of the previous management of the lambs on their progress in fattening. They received corn fodder and roots, and all they would eat of a grain mixture of 2 parts of oats, 1 part of corn (both unground) and 1 part of linseed meal.

The lot that did not receive any grain previous to fattening made a greater gain of but 8 pounds, and the cost of the gain was only 3 cents less than that of the other lot. As both lots were urged as rapidly as it was possible by forced feeding the difference in the progress seems small. It may be said that the previous feeding of the lambs had no effect on their progress in fattening during the third period.

A financial statement shows that "it paid to feed the lambs grain through all the periods." The lambs fed grain continuously sheared 10.1 pounds of wool per head, while those fed no grain until the last period, sheared 7 pounds per head. The wool of the former was longer than that of the latter, and contained more yolk.

Shearing wethers before fattening, J. A. CRAIG (*Wisconsin Sta. Report for 1892, pp. 24–28*).—This is a continuation of an experiment reported in the Annual Report of the station for 1891 (E. S. R., vol. IV, p. 184). Six Shropshire grade wethers of even fleece and form were divided into two lots, lot 2 being shorn November 4 and lot 1 left unshorn. The condititions and food were the same for both lots. March 5 both lots were shorn. The results of the trial are tabulated and discussed.

"The first experiment, in which the wethers were first shorn in December, was decidedly unfavorable to the practice, while that in which the twice-shorn wethers were first shorn in November affords evidence of some advantages connected with shearing twice that can not be overlooked."

The experiments are to be continued.

Cross-breeding Shropshire and Merino sheep, J. A. CRAIG (*Wisconsin Sta. Report for 1892, pp. 42–52, figs. 4*).—This is a continuation of the work reported in the Annual Report of the station for 1891 (E. S. R., vol. IV, p. 187), in crossing a Shropshire on an American Merino. The report is on the first, second, and third crosses.

In quality the wool of the first cross is slightly inferior to the Merino, and much superior to that of the Shropshire. It is finer, softer, and purer than that of the Shropshire, while it is only inferior to the wool of the Merino in fineness.

In condition the first cross wool is bright, and owing to the density of the fleece it keeps clean. The wool might be improved somewhat in respect to its strength, for it appears to have lost some of the elasticity and strength of fiber that is noticeable in the Merino wool. * * * The body of the sheep shows marked improvement towards a mutton type from that of the Merino. * * *

The wool of the second cross ewes is longer than that either of the Merino or the first cross, but it is not equal to them in density or evenness. It is inferior in fineness, softness, and purity, but in these respects it is superior to the typical Shropshire wool. It is a bright, strong, and long wool that would bring a high price in present markets. * * *

In critically examining the appearance of the second cross it is evident that the Shropshire type is closely approached. In form the sheep of this cross are long and possessed of the rotundity of form that is a Shropshire characteristic. * * * A marked improvement has been made over the first cross, particularly in the plumpness of the thigh and fullness between the hind legs. There appears to be no evidence of a decrease in constitution. * * *

It would be a hard matter for a novice to distinguish between the best of them and pure bred Shropshires. * * *

As the third crosses are the lambs of this year it would be attempting too great a forecast to place an estimate on them based on their present appearance. They do not, however, show many of the loose folds of skin that have been observable in the lambs of the first cross at their ages. It seems that they will be very similar to the second cross in type and fleece. We have, however, sufficient data from the

previous crosses to believe that they point the way to those who wish to supplant their Merino flocks with sheep of mutton qualities.

The production of turkeys, S. CUSHMAN (*Rhode Island Sta. Bul. No. 25, Sept., 1893, pp. 89–123, plates 3*).—Turkey raising in Rhode Island, which was formerly carried on quite extensively, is said to be on the decline. This, it is explained, is largely due to the damage done to certain crops when the fowls were allowed to roam over the farms, and to the ravages of foxes and other enemies, including a disease which carried off the young turkeys at a certain age.

"Believing that the lack of vitality and hardiness in the stock used was one of the greatest difficulties in the way of success with turkeys, our first move was to procure a pure American wild gobbler, for crossing with the domestic turkey." Experiments in this line in two seasons are reported.

Of the forty early turkeys, twenty-five have survived and they look well. They are about half grown and weigh from 5 to 6 pounds each. They have seemed very strong and active, and when caught have felt unusually heavy and firm in flesh and plumage. They are also more tame and fearless when treated gently than the domestic turkey, but if frightened or caught they are as much more determined to escape. They show the wild plumage in a slight degree at this age as well as larger necks and slimmer heads. More than half of them are from the large bronze hen.

Although we had no better success raising turkeys the first season than others in this neighborhood, having lost about 50 per cent of the young and a number of the old, we have as yet seen no symptoms other than would occur from overfeeding, digestive derangements, or lack of inherited vigor. Bowel troubles seem to be more prevalent among turkeys than any other disease, and a bird that gets sick is very apt to die. * * *

In August, fowls that have been overfed and that are confined in hot yards are subject to bowel trouble. When once started it is apt to be quickly fatal. There is diarrhea, weakness, no appetite, and the face and comb change from a bright scarlet to a dark purple. As soon as this dark purple is shown, the bird dies unless vigorous remedies are promptly given. We have saved fowls, apparently in the last stages, by administering two or three drops of liquid camphor on bread crumbs every half hour. It is always best to watch stock so closely that the commencement of such trouble is noticed, when, in most cases, it may be easily corrected by giving in the food, ginger or black pepper and powered chalk or charcoal.

The bodies of the young turkeys that have died were examined, and in almost every instance the livers were found to be diseased. As to whether this is caused by contagious germs, or simply by overfeeding and other unfavorable circumstances, we hope to be able to give something definite in the near future.

A large part of the bulletin is occupied with accounts of the methods of successful turkey raisers, turkey raising on Block Island, characteristics of wild turkeys, and wild turkey crosses.

Wild turkey crosses are hardier and healthier than common turkeys and rarely have disease. Half blood hens are generally too wild, but half blood goblers are not as wild and are suitable for crossing with domestic hens. A small proportion of wild blood improves the size, form, and general appearance, as well as the vigor, without being a disadvantage in any way. A quarter wild cross is better for practical breeding than a pure wild or half wild bird. Half wild crosses do well if

allowed a large range, but are not well suited for woody countries or as easily kept on small places as the domestic turkey.

Wild turkey hens under domestication and wild first cross hens often disappear in the spring and are not seen until fall when they usually return to their own home with a brood of nearly full grown turkeys. Half blood mothers make their young too wild. Half bloods reared by domestic turkey hens are not much inclined to stray. Quarter bloods, under certain conditions, may be as wild as the wild bird of the woods. * * *

The wild blood gives the cross an astonishing ability to care for themselves. It is apt to have the strongest influence in breeding. If first crosses are bred together the stock resembles the pure wild, and after several generations can not be distinguished from the pure wild by good judges. The older the bird grows the more he shows the wild blood. Crosses have much of the superior game flavor of the wild and command a higher price for the table.

Some wild bronze crosses that are half and three quarters wild blood are as large as the pure bronze turkeys. Several years crossing, however, with the selection of the largest for breeding each season gives the greatest size.

DAIRYING.

E. W. Allen, *Editor.*

Factory notes, S. M. Babcock (*Wisconsin Sta. Report for 1892, pp. 258–263*).—In 1891 and 1892 students from the Wisconsin Dairy School were requested to make monthly reports of their work. In this way reports were received from twenty-nine creameries and fifty two cheese factories in different parts of the country. This article is a summary of deductions from these reports.

Creameries.—Twenty-one creameries report an average in the best part of the season of 35 patrons, and 4,450 pounds of milk per day. Seventeen report an average of 209 cows with 3,829 pounds of milk per day, or 18.3 pounds per cow per day. * * *

Reports from five creameries that made tests in 1891 show an average of 3.82 per cent of fat, and nineteen creameries in 1892 showing an average of 3.70 per cent fat in the milk received.

In 1891 the yield of butter from 1 pound of fat in the milk was 1.113 pounds, in 1892 it was 1.166 pounds. The increased yield in 1892 may be partially attributed to improved appliances, but I believe it is chiefly due to a more general and more intelligent use of the test in locating and avoiding losses. This is borne out by the tests of skim milk and buttermilk for the two years. In 1891 the average per cent of fat in the skim milk was 0.33, with a range from 0.1 to 0.5; in the buttermilk the average was 0.31, with a range from 0.1 to 0.6. In 1892 the fat reported in the skim milk ranged from a trace to 0.3 per cent with an average of 0.13 per cent. In calculating this average all reports of a trace of fat have been placed at 0.08 per cent. The average per cent of fat in the buttermilk for 1892 was 0.247, with a range from a trace of 0.6 per cent. * * *

Cheese factories.—Forty cheese factories report in the best part of the season an average of 31 patrons and 5,017 pounds of milk per day. Thirty-seven of these factories report an average of 263 cows and 5,360 pounds milk per day, an average of 20.4 pounds per cow per day. * * *

In 1891 the average was 3.723 per cent of fat in the milk used and in 1892, 3.624 per cent. * * * For the two years the average as derived from 177 reports is 3.662 per cent of fat.

Combining the reports from creameries and cheese factories, the average percentage of fat in the milk delivered each month of the year is calculated.

Eighty-four reports in 1891 give an average yield of 1 pound of cured cheese from 10.55 pounds of milk.

One hundred and nine reports in 1892 give an average yield of 1 pound of cured cheese from 10.471 pounds of milk.

In the two years 169 reports gave both the per cent of fat in the milk and the yield of cured cheese; the average of these is:

Fat content of milk = 3.658 per cent.
Milk for 1 pound cured cheese = 10.473 pounds.
Cheese from 100 pounds of milk = 9.548 pounds.
Cured cheese for 1 pound fat = 2.61 pounds.

[The table of averages by months] shows a very close correspondence between the per cent of fat and the yield of cheese throughout the whole season, and although complete analyses of the milk are not given, it indicates that the casein of the milk increases with advancing lactation at very nearly the same rate as the fat. * * *

[Grouping the results according to the percentage of fat in the milk] shows a gradual falling off in yield of cheese as the per cent of fat increases, and indicates that at the same season of the year the ratio of fat to casein is slightly less in rich milk than in poor milk.

The average yield of cheese when referred to 1 pound of fat in milk is very nearly the same as was obtained by Dr. Van Slyke* in New York factories. * * *

The average loss of fat reported in whey has been 0.324 per cent, with a range from 0.1 to 0.6 per cent. The loss seems to be practically independent of the amount of fat in the milk and to depend more upon the condition of the milk than any other factor. Tainted and overripe milks are nearly always accompanied by large losses in the whey.

The reports show clearly that the "relative value plan" is growing in favor in both creameries and cheese factories.

Directions for using the Babcock milk test, S. M. BABCOCK (*Wisconsin Sta., Report for 1892, pp. 219–244*).—A reprint from Bulletin No. 36 of the station (E. S. R., vol. v, p. 82), together with a letter from E. H. Farrington, covering the same points in the use of the Babcock test as Bulletin No. 27 of the Illinois Station (E. S. R., vol. v, p. 323.)

Detection of adulterations in milk, S. M. BABCOCK (*Wisconsin Sta. Report for 1892, pp. 245–257*).—A reprint from Bulletin No. 36 of the station (E. S. R., vol. v, p. 82).

AGRICULTURAL ENGINEERING.

The construction and filling of a round silo, F. H. KING (*Wisconsin Sta. Report for 1892, pp. 121–128, figs. 2*).—*Construction and cost* (pp. 121–127).—The construction of a round silo, 16 feet outside diameter and 27 feet deep, holding 80 tons, is described in detail. The silo is constructed in the main like the round silos described in Bulletin

*N. Y. State Bul. No. 50 (new series); E. S. R., vol. IV, p. 945.

No. 28, and the Annual Report of the station for 1891 (E. S. R., vol. III, p. 251). The cost of this silo was $175.99 for materials, and $72.03 for labor, a total of $248.02.

Mention is made of a silo 20 feet in diameter and 30 feet deep built by a farmer at a total cost of $315, including labor; and of another 20 feet in diameter and 33 feet deep which cost $300.

Capacity (pp. 127, 128).—The weights of a cubic foot of silage in the above mentioned round silo of the station was determined at different times during filling and afterwards. The corn put into the silo had an average of 65.5 per cent water.

One day after putting in 47,189 pounds the depth was 11.75 feet and the mean weight per cubic foot 24.12 pounds. In the morning of September 10, two days after filling began the silage had a depth of 10.5 feet and an average weight per cubic foot of 27.19 pounds. September 10, in the afternoon, 16,636 pounds more were put in and the next morning the depth was $13\frac{1}{3}$ feet, with a mean weight of 28.56 pounds per cubic foot; the next morning with no more silage added the depth was $12\frac{5}{6}$ feet, and the mean weight per cubic foot, 29.71 pounds.

During the day, September 12, 52,561 pounds of silage were added, increasing the depth to 23 feet and leaving the mean weight of silage 29.5 pounds per cubic foot. The next morning, September 13, the silage had a depth of $22\frac{1}{6}$ feet and a mean weight of 30.65 pounds. The next morning, thirty-six hours after last filling, the depth was 21 feet, and the mean weight of silage 32.41 pounds per cubic foot.

September 15, a. m., two and a half days after filling, the depth was $20\frac{2}{3}$ feet and the mean weight per cubic foot 32.95 pounds; and this same morning 27,382 pounds more silage were added, making a depth of 27 feet and filling the silo to the top, leaving the mean weight of silage per cubic foot, 30.91 pounds.

On the morning of September 17 the silage had settled to a depth of 25 feet, having then a mean weight of 33.45 pounds per cubic foot. Two days later the depth was $24\frac{1}{6}$ feet, and the mean weight per cubic foot was 34.64 pounds.

For fear of frost the balance of the corn was cut and shocked on September 14, where 27,382 pounds stood until the next morning, and the balance until the morning of September 19, when 10,820 pounds more were put in, making the total weight put in 77.29 tons. This last corn put in contained only 45.14 per cent of water, and the 27,382 pounds only 58.51 per cent instead of 69 per cent, the average for what was put in before. * * *

Two days after putting in the last silage the depth was $26\frac{5}{6}$ feet, and the mean weight per cubic foot, 33.45 pounds; and on September 28, nine days after filling, the depth of silage was $25\frac{1}{3}$ feet, and the mean weight per cubic foot, 35.48 pounds.

On April 18, when the surface of the silage was $20\frac{5}{6}$ feet below where it was two days after filling, and $19\frac{1}{3}$ feet below where it was when settling had ceased, the mean weight per cubic foot, as found by cutting out and weighing 7 cubic feet, was 55.25 pounds. This weight is 3.75 pounds less than the computed weight given for 21 feet (in a larger silo) in the last Annual Report, p. 244. [E. S. R., vol. IV., p. 148.] * * *

This experiment indicates that with corn containing 69 per cent of water at the time of filling, a silo 15 feet inside diameter and resting upon a stone basement 13 feet inside diameter and 3 feet deep, will hold silage when of different depths, as follows:

Capacity of small round silos.

With depth 12 feet	24 to 26 tons
With depth 14 feet	32 to 34 tons
With depth 23 feet	53 to 55 tons
With depth 27 feet	80 to 82 tons

STATION STATISTICS.

Report of the treasurer of Florida Station (*Report of the Treasurer of the Agricultural Experiment Station Fund of Florida*).—This is for the fiscal year ending June 30, 1892.

Fifth Annual Report of Kansas Station (*Kansas Sta. Report for 1892, pp. 14*).—Brief general remarks on the work of the year, outline of bulletins published, a list of publications previous to 1892, an index of the report and bulletins for the year, and a financial statement for the fiscal year ending June 30, 1892.

Fifth Annual Report of Maryland Station (*Maryland Sta. Report for 1892, p. 21, plate 1*).—This includes the report of the director on the work of the year, and separate reports by the chemist, horticulturist, and treasurer, the latter for the fiscal year ending June 30, 1892.

The tobacco work planned and undertaken at the station was almost an entire failure, owing to the dry weather and severe heat which followed immediately after setting out the plants. Tests of the flue system of curing tobacco undertaken on two farms in the State were not very successful, owing to the season, but gave encouragement of better results in a more favorable season.

Report of director of Wisconsin Station, (*Wisconsin Sta. Report for 1892, pp. 1–8*).—A brief survey of the work carried on in the different departments during the year, and a list of the bulletins and reports of which the station has copies for distribution on hand.

Financial statement (*Wisconsin Sta. Report for 1892, p. 335*).—This is for the fiscal year ending June 30, 1892.

ABSTRACTS OF PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE.

Proceedings of the tenth annual convention of the Association of Official Agricultural Chemists, H. W. WILEY (*Division of Chemistry, Bul. No. 38, pp. 218*).—This is the report of the convention held at Chicago, August 24, 25, and 26, 1893. It includes reports of reporters, discussion, papers read, and methods adopted for 1893–'94 for phosphoric acid, nitrogen, potash, foods and feeding stuffs, dairy products, soils, sugar, and fermented liquors. The address of the president, S. M. Babcock, contains the following suggestions:

> If I am asked what can be done to throw more light upon the composition and value of fodders than is done by the present method, I would suggest a closer study of the nitrogenous principles of fodders, and that an attempt be made to identify some of the constituents which make up the nitrogen-free extracts of the present system. I would determine the sugar, the starch, and the gums; and, so far as practicable, I would discriminate between the pure cellulose, the lignins, and other constituents of crude fiber. I would separate the glycerides from the ethereal oils, the coloring matter, and the wax, which the ether extract contains. In general, I would substitute for the present illogical, indefinite, and unmeaning system, one which, so far as it went, would deal with the proximate constituents which the fodders contain. * * *
>
> Progress along the lines suggested need not be slow, for we have a large number of workers; and if these will devote one half the time to this subject which is now wasted in endeavors to make the sum of analytical errors represented by the term nitrogen-free extract agree in duplicate analyses to the second decimal place, we will in the next decade not only have methods which are applicable to this work, but we will have collected a mass of facts which can not fail to throw new light upon feeding problems.

Only minor changes were made in the recommendations of last year. The principal changes made were as follows: For absorbing the ammonia in the Kjeldahl distillation, besides hydrochloric acid, standard sulphuric acid may be used, its strength being determined by barium chloride. In the Kjeldahl method adapted to nitrates, 5 grams of sodium thiosulphate is recommended in preference to 10 grams of sodium sulphide. The Gunning method modified for nitrates, as recommended by E. B. Voorhees in the meeting of the Association last year, and in Bulletin No. 112 of the Connecticut State Station (E. S. R., vol. IV, p. 336), with the exception that sodium thiosulphate be used as the reducing agent, is made an official method. In sugar analysis 10 grams are to be used for water determination instead of 3,

and the Alberti and Hempel method for ash determination is made official. When ash is determined with the aid of sulphuric acid the weight of the ash is to be corrected by deducting one tenth. The reporter for the coming year is to investigate drying in air, in vacuum, and by the Josse method. Babcock's gravimetric (asbestus) method for total solids and fat in milk was made official. The provisional methods for cheese, soil, and ash analysis were continued.

The report includes the following papers: Determination of citrate-soluble phosphoric acid, B. B. Ross; Notes on the analysis of concentrated phosphates, Stillwell and Gladding; Notes on the preparation of fertilizer samples for analysis, Stillwell and Gladding; Availibility of nitrogen in mixed fertilizers, B. Terne; Results obtained in standardizing the more common acid and alkali solutions, C. G. Jenter; Vessels for acid-digestion of soils, R. C. Kedzie; Modification of Grandeau's method for the determination of humus, H. A. Huston and F. W. McBride; Determination of casein in cows' milk, L. L. Van Slyke; Determination of fat in cheese, L. L. Van Slyke; Determination of acidity in milk, L. L. Van Slyke; The Babcock gravimetric method for the determination of solids and fat in milk, A. L. Winton; Preliminary investigations relating to the determination of crude fiber, H. A. Huston and F. W. McBride; Suggestions for the better management of food examinations, W. Dickoré; and Methods proposed for adoption for use in Austria for the analysis of wines, beers, etc., Roessler.

Miscellaneous investigations concerning infectious and parasitic diseases of domestic animals (*Bureau of Animal Industry, Bul. No. 3, pp. 85, plates 3*).—A report on investigations which are either the outgrowth of more important researches already published or else fragments of such work on infectious and parasitic diseases of domesticated animals.

Observations on the morphology, biology, and pathogenic properties of twenty-eight streptococci found in the investigation of animal diseases, V. A. Moore (pp. 9–30).—The author summarizes the principal results of his investigations as follows:

(1) Streptococci are very generally distributed in nature, and especially on the mucous membranes of healthy animals. They fall very naturally into two classes: (1) Those that are strongly saprophytic in all of their properties; and (2) those that have decidedly parasitic tendencies in their morphological and cultural characters. The second class only has been found (by the writer) in diseased animal tissues.

(2) Under certain conditions, presumably a weakened condition of the body with lesions of the mucosa in the air passages or intestinal tract, the streptococci of the mucous membranes invade the inner cavities and organs of the body. The large number of streptococci frequently found in the tissues indicate their invasion and subsequent multiplication prior to the death of the animal.

(3) The streptococci that have been isolated in my investigations are capable of being differentiated by one or more distinct and apparently constant characteristics. In several instances, however, the differences are very slight, and may be due to previous conditions of life or unobserved irregularities in their cultivation.

(4) Streptococci, quite as delicate and parasitic in their cultural characters as those obtained from diseased organs, are found in the flora of water and the mucosa

of healthy animals, although no two of these contrasted species (?) have been found that possess precisely the same properties.

(5) The grouping of the pathogenic and non-pathogenic streptococci by Von Lingelsheim into *Streptococcus longus* and *Streptococcus brevis* does not hold true with all the forms that I have studied. The pathogenic effect of at least the majority of the destructive forms is septic in its character. Their virulence is soon lost.

(6) Like other bacteria, streptococci are frequently found in the organs of animals that have perished from different and widely separated diseases. A few of these streptococci, as well as a small per cent of those from other sources, have been found to be fatal to certain of the experimental animals, while a large majority of them possess (when isolated) no pathogenic powers whatever as indicated by animal inoculations.

A non-motile pathogenic bacillus closely resembling the bacillus of hog cholera found in the lung and spleen of a pig, V. A. Moore (pp. 31–37).

In the bacteriological examination of the spleen and a portion of the lung of a pig early in 1891, a non-motile bacillus was discovered which, on account of its pathogenic properties, has been somewhat carefully studied. Its appearance in a bouillon culture from the spleen and in stained cover-glass preparations from the bronchial secretions of the lung suggested a slightly modified form of the swine-plague germ. Further investigation, however, showed that biologically and in its effect upon animals it resembled very closely the hog-cholera bacillus * * * in (1) its biological characters; (2) the light center and deeply stained periphery in cover-glass preparations; (3) the appearance of the bacteria in pairs in preparation from animal tissues, and (4) the character of the lesions produced in experimental animals. It differs from it in (1) morphology, (2) its feeble resistance to drying, (3) the small number of bacteria present in the tissues of animals dead from its inoculation, and (4) it is more rapidly fatal to rabbits. Its non-motility, however, is the only *specific* difference that can be considered between it and the bacillus of hog cholera. Cultures on the various media have been very carefully examined in the very early and advanced stages for the purpose of determining whether or not this germ was motile under any of the ordinary conditions of cultivation, or at any age of the culture, but only negative results were obtained. * * * After these tests this bacillus can be safely considered a non-motile organism.

Although morphologically it resembles the swine-plague group of bacteria its cultural characters and pathogenic effect on animals differentiate it very distinctly from that group of organisms. The differences between it and the swine-plague and hog-cholera bacteria appear to be sufficiently great to consider it a species rather than a modified form of either of the specific disease germs. * * * Although it was universally fatal to experimental animals, there is very little if any evidence that it was to any degree responsible for the death of the pig from which it was obtained. This fact renders it of little economic importance when considered with reference to this case alone, but it seems reasonable to suppose that a germ which possesses such marked pathogenic properties might, under certain conditions, be the cause of a more or less serious outbreak of infectious disease.

Pathogenic and toxicogenic bacteria in the upper air passages of domesticated animals, V. A. Moore (pp. 38–48).—As the result of the author's investigations and of previously published researches—

It is found that 48 per cent of pigs, 80 per cent of cattle, 50 per cent of sheep, 16 per cent of horses, 90 per cent of cats, and nearly 30 per cent of dogs contain among the flora of their upper air passages bacteria which possess more or less pathogenic or septic properties. Of these the greater number belong to the swine-plague group, and can be designated as pathogenic bacteria, while the other forms which possess only temporary destructive power appear to more properly belong to the

toxicogenic bacteria. The extremely attenuated forms from the sheep and the great variation found in the pathogenic properties of those from the cats are interesting in showing the graduation of the swine-plague group of bacteria from the very virulent to the extremely attenuated forms.

The close resemblance of the pathogenic bacteria to the swine-plague germs has been determined by a large number of inocculations and parallel cultures, and by a careful study of their morphology in both fresh and stained preparations. Their feeble power to resist drying and their thermal death point are identical with those of the virulent swine-plague bacteria. * * * The very general distribution, in the secretions covering the mucosa of the upper air passages of domesticated animals, of bacteria which possess such marked pathogenic and toxicogenic properties, is of much importance, as it explains the cause of sporadic cases of swine plague, and, to some extent, at least, the possible source and significance of various toxicogenic bacteria which are frequently isolated from variously diseased animal tissues.

An outbreak of abortion in mares, F. L. Kilborne (pp. 49–52).—A report on an outbreak of abortion in a large stud. An account of disinfecting measures is given. Vaginal injections of pure cultures of the bacillus present in cases of abortion were made on one pregnant mare and two pregnant cows, and intravenous inocculation of two pigs were made with similar cultures.

On a pathogenic bacillus from the vagina of a mare after abortion, T. Smith (pp. 53–59).

The results of this investigation may be briefly summarized as follows:

(1) The discovery of a pathogenic bacillus in the vagina of a mare soon after abortion.

(2) The very close relationship between this bacillus and the hog-cholera bacillus.

(3) The production of a slight discharge by the injection of cultures into the vagina of a pregnant mare and two pregnant cows.

(4) The absence of this bacillus from the genital passages of one pregnant and four non-pregnant mares.

Some experimental observations on the presence of tubercle bacilli in the milk of tuberculous cows when the udder is not visibly diseased, T. Smith and E. C. Schroeder (pp. 60–66).—An account of experiments in which Guinea pigs were inoculated with milk from tuberculous cows.

Additional observations on Texas cattle fever, T. Smith, F. L. Kilborne, and E. C. Schroeder (pp. 67–72).—The principal facts of this investigation are thus summarized by the authors:

(1) The indefinite persistence of the micro-parasite of Texas fever in the blood of Southern cattle after removal from the enzoötic territory.

(2) The persistence (for nearly a year) of this micro-parasite in the blood of an inoculated native.

(3) The production of a severe case of this disease in midwinter by inoculation.

(4) The destruction of the micro parasite in a quantity of defibrinated blood kept sixty-eight days before it was tested by inoculation.

(5) The probable development of a simple method of preventive inoculation by the use of blood from Southern cattle.

Preliminary notes on a sporozoön in the intestinal villi of cattle, T. Smith (pp. 73–78).—Notes on this sporozoön as observed during a portion of its life history.

On the presence of sarcosporidia in birds, C. W. Stiles (pp. 79–85).—Notes on *Balbiania rileyi* n. sp., *B. falcatula* n. sp., *Sarcocystis falcatula* n. sp., and several doubtful species.

Insect Life (*Division of Entomology, Insect Life, vol. VI, No. 1, Nov., 1893, pp. 58, fig. 1*).—This number contains the following articles:

An important predatory insect (*Erastria scitula*, pp. 6–10).—An editorial review of a paper by Dr. H. Rouzaud, of Montpellier, France, in which the habits and metamorphoses of this predatory Lepidopterous insect are described. It feeds in the larval state upon *Lecanium oleæ*, and it is proposed to attempt to introduce it into this country for the purpose of ridding the olive trees of this scale insect in California.

Notes on Tasmanian Coccinellidæ, E. H. Thompson (pp. 11–12).

Experiments with the hop louse in Oregon and Washington, A. Koebele (pp. 12–17).—A report of an investigation made under instructions from the entomologist during the early summer of 1893, at different points in Oregon and Washington. Natural enemies of the *Phorodon* in these States are mentioned, and the results of a series of experiments with remedies are given. The use of the resin wash as a spray and hand-picking plum trees in the spring are recommended.

Report on outbreaks of the western cricket, and of certain locusts in Idaho, R. Milliken (pp. 17–24).—An account of the damage done in Idaho during 1893 by the western cricket and several species of non-migratory locusts. This report supplements the report by L. Bruner on the damage done in 1891 and 1892, published in Bulletin No. 27 of the Division of Entomology (E. S. R., vol. III p. 907).

The present status of the recent Australian importations, D. W. Coquillett and A. Koebele (pp. 24–29).

On the injurious and other locusts of New Mexico and Arizona, C. H. T. Townsend (pp. 29–32).

Extracts from correspondence and general notes (pp. 32–58).—Among the topics treated are the following: The corn root louse, destructive locusts in Colorado, termites swarming in houses, an alfalfa worm in Wyoming, a new scale insect in Florida, the stink bush as an insecticide, the sweet potato weevil in Jamaica, the carnation "twitter;" migratory locusts in Chile, the mosquito in England, the peach maggot fly, hop lice in New York, a homemade sprayer, the horn fly in Alabama, damage by chinch bugs, Australian sugar cane insects, and insects in the human ear.

Insect Life (*Division of Entomology, Insect Life, vol. VI, No. 2, Dec., 1893, pp. 59–206, figs. 4*).—This number contains the proceedings of the meeting of the Association of Economic Entomologists, held at Madison, Wisconsin, August 14–16, 1893. The following papers are printed in full:

President's address, S. A. Forbes (pp. 61–70).—A classified review of the work of the year in economic entomology, with suggestions as to methods of work and presentation of results, and as to possibilities in

the way of coöperation upon certain topics among the members of the Association.

Methods of treating insects affecting grasses and forage plants, H. Osborn (pp. 71–82).—The injurious species are grouped according to character of work and seasons of appearance, and the remedies are considered under the two heads of "agricultural methods" and "direct methods." A table of the injurious species follows, in which the exact condition of every species at any given time of the year is indicated.

Notes on methods of studying life histories of injurious insects, L. O. Howard (pp. 82–89).—The vivarium methods in use in the Division of Entomology, U. S. Department of Agriculture, are described at some length, and also a number of important features connected with outdoor work. The great superiority in value of outdoor observations as compared with vivarium study is insisted upon.

Another mosquito experiment, L. O. Howard (pp. 90–91).—An account of a second experiment in the treating of breeding pools of the mosquito with kerosene oil, in which it is shown that by the judicious expenditure of $1.70 perfect immunity from mosquitoes was obtained at a country house near Washington.

Phytomyza affinis as a cause of decay in clematis, J. Ritzema Bos (pp. 92–93).—A clematis disease prevalent in gardens in the Netherlands, and formerly ascribed to the work of anguillulids, is shown to be caused by the larvæ of *Phytomyza affinis*. The cutting and burning of the infested portions early in the season is recommended.

Farm practice and fertilizers as insecticides, J. B. Smith (pp. 93–97).—A number of examples are cited in which chemical fertilizers have been found to possess insecticide qualities. The combination of intelligent farm practice with the proper use of chemical fertilizers will be the main reliance of the farmer in future in his warfare against insects.

The preservation of larvæ for study, H. Garman (p. 98).—The author recommends placing the larvæ for fifteen seconds in water heated to the boiling point before transferring to graded strengths of alcohol. As a substitute for alcohol he recommends 250 c. c. of boiling water, 3 teaspoonfuls of common salt, 1 teaspoonful of powdered alum, and 5 drops of pure carbolic acid.

The distribution of Coccidæ, T. D. A. Cockerell (pp. 99–103).—The author calls especial attention to the number and variety of neotropical *Coccidæ*, and follows with a statement concerning the geographical distribution of several species which he has had under observation in the West Indies.

Note and record keeping for the economic entomologist, A. D. Hopkins (pp. 103–108).—An account of the system of card records in use by the author, in which he combines two catalogues, the one for accessions and the other for species.

Illustrations for the economic entomologist, H. Garman (pp. 109–

114).—A general consideration of the objects to be gained by illustrations and a summary review of the different methods in use.

The arsenites and arsenical mixtures as insecticides, C. P. Gillette (pp. 115–121).—An historical review of the introduction and use of the several arsenical mixtures.

Destructive Scolytids and their imported enemy, A. D. Hopkins (pp. 123–129).—An account of the damage done by *Dendroctonus frontalis* and other Scolytids to the coniferous forests of West Virginia, and of the attempt made by the author to introduce a predaceous European beetle (*Clerus formicarius*) into West Virginia for the purpose of preying upon these destructive insects.

Parasitic and predaceous insects in applied entomology, C. V. Riley (pp. 130–141).—The practical utilization of parasitic and predaceous insects may be brought about by the protection of those species which already exist in a given locality and the introduction of desirable species which do not already exist there. The author shows that the first method offers few opportunities, but instances several in which good results have been accomplished. He follows with a review of the attempts which have been made under the second method, from the first suggestion made by Bethune concerning the introduction of the European parasites of the wheat midge down to the latest attempts made by himself to bring over the European parasites of the Hessian fly. He shows that instances in which good may be accomplished by this method are very few and that the circumstances must be exceptional. He points out the complicated laws governing the interactions of organisms, and shows that in general parasitic and predatory species can not be artificially encouraged beyond certain limits. Economic entomologists, however, are urged to be on the outlook for special and unusual cases where the introduction of beneficial species may be desirable.

The economic value of parasites and predaceous insects, J. B. Smith (pp. 142–146).—The author considers that the economic value of these species has been greatly overestimated. Excessive increase only of injurious species is checked by the enemies of injurious species. Nature tends to preserve a balance, and many species most subject to parasites are equally abundant every year. Instances in support of this view are given, and the conclusion reached is that, aside from certain exceptional cases, such as that of Vedalia and Icerya, parasites and predaceous insects have absolutely no economic value, and most injurious insects must be treated without regard to these natural aids.

Insect foes of American cereal grains, with measures for their prevention or destruction, F. M. Webster (pp. 146–157).—The writer summarizes in general terms the principal enemies to cereal crops and gives the broader and more comprehensive remedial measures, such as good farming, intelligent rotation of crops, and improved agricultural methods in general. A new corn enemy (*Hadena fractilinea*) is figured and described.

Fumigation with bisulphide of carbon for the complete and rapid destruction of insects which attack herbaria, furs, and woolens, H. du Buysson (pp. 159–161).—The author describes a fumigating chest with an air-tight water joint and advocates the use of such a chest for the preservation of furs and woolens and of the stuffing of furniture and saddles, as well as for the disinfection of clothing in epidemics.

Aphelenchus olesistus n. sp., a nematoid worm, cause of a leaf-sickness in begonia and asplenium, J. Ritzema Bos (pp. 161–163).—A nematoid worm mentioned by Prof. G. F. Atkinson in Insect Life, vol. IV, p. 31, is stated by the author to resemble closely, and probably to be identical with, a new species which he describes as *Aphelenchus olesistus* and which occurs in Europe in the leaves of asplenium and begonia. A description of the species is given.

Methods of attacking parasites of domestic animals, H. Osborn (pp. 163–165).—A review of the latest methods, including the application of kerosene emulsion, different sheep dips, tobacco, sulphur, pyrethrum, snuff, fumigation with tobacco and sulphur, and the feeding of sulphur with salt.

Remedies for insects injurious to cotton, H. E. Weed (pp. 167–170).—A brief consideration of *Aletia xylina* and *Heliothis armigera*, with an account of the use of the "Cotton Dry-poison Duster," consisting of a pole six feet long, at each end of which is attached an Osnaburg bag containing dry poison, which is shaken from the bags upon the leaves of the cotton by the operator, who is mounted on a horse or mule. The use of trap crops, particularly corn, against the bollworm is recommended.

The cheese or meat skipper, M. E. Murtfeldt (pp. 170–175).—An account of the life history of this species, drawn from original observations necessitated by the absence of available published accounts.

Hydrocyanic acid gas as an insecticide, D. W. Coquillett (pp. 176–180).—An account of the development and the present use of this insecticide measure in California.

On arsenical spraying of fruit trees while in blossom, J. A. Lintner (pp. 181–185).—A review of the experiments which have been made in this direction. These are shown to have been unsatisfactory. The author recommends the actual analysis of the stomach contents of bees which have visited sprayed blossoms. A list of the insects which should be treated by spraying with arsenites at the time of blossoming is appended.

Some insects of the year, F. M. Webster (p. 186).

Insects of the year in New Jersey, J. B. Smith (pp. 187–192).

Notes on some of the more important insects of the season, H. Osborn (pp. 193, 194).

Icerya purchasi and Vedalia cardinalis in New Zealand, R. A. Wight (pp. 194, 195).

Notes on some insect pests of Trinidad, F. W. Urich (pp. 196–198).

Notes on slip-records, T. D. A. Cockerell (pp. 198–200).

Dipterous parasites in their relation to economic entomology, C. H. T. Townsend (pp. 201–204).

Handbook of Experiment Station Work (*Office of Experiment Stations, Bul. No. 15, pp. 411*).—This is a popular digest of the publications of the agricultural experiment stations in the United States since their establishment, including the earlier work of the older stations. The matter is arranged by subjects grouped alphabetically with numerous cross references. In all about eight hundred and thirty-five subjects are treated, many of which include numerous subheads. In addition to these short summaries, quite full lists of references are given to the original station publications under each subject. Hence the Handbook is an index to station literature, as well as a popular résumé. An appendix contains tables showing the average composition of American feeding stuffs; the average fertilizing constituents of American feeding stuffs; the composition of vegetables, fruits, and nuts; the composition of commercial fertilizing materials and farm manures; and the ash constituents of different woods.

ABSTRACTS OF REPORTS OF FOREIGN INVESTIGATIONS.

Recognition of lead in water brought through lead pipes, M. T. Lecco (*Chem. Ztg.*, *17* (*1893*), *No. 78*, *pp. 1431. 1432*).—By means of the following method the author was able to recognize with certainty 0.05 mg. of lead per liter of water without waiting for the sulphureted hydrogen precipitate to settle: One liter of water acidulated with acetic acid was evaporated to between 100 and 200 c. c., filtered, and a few drops of sulphureted hydrogen water added. The slightest trace of lead is plainly recognized by a dark coloration of the water, without any annoying cloudiness. When a small excess of sulphureted hydrogen is added the water soon becomes so cloudy that the presence of lead is recognized with difficulty. One cubic centimeter of ordinary saturated solution of sulphureted hydrogen is sufficient to precipitate 30 mg. of lead. Hence, it is advisable to dilute the saturated solution two or three times.

A method recommended for colorometric determination of lead in water is carried out similar to the ammonia determination with Nessler solution, using a solution of lead containing 0.01 mg. of lead in 1 c. c.

The author examined water coming through a newly-laid lead pipe. The solvent action of the water was greater at first than later, but after three months 0·3 mg. per liter of lead was found in water which had stood in the pipe twenty-four hours, and a trace was perceptible after three hours standing. No lead was detected in water which ran through the pipe without standing.—E. W. A.

Determination of phosphoric acid, A. Villiers and F. Borg (*Bul. Soc. Chim. Paris*, *9–10* (*1893*), *No. 13*, *pp. 486–490*).—The authors found that when molybdic solution, prepared by dissolving 150 grams of molybdate of ammonia in lukewarm water, diluting to 1 liter and pouring into 1 liter of nitric acid of 1.2 specific gravity, is added to a solution of phosphoric acid in the cold, and the solution then warmed at 40° C. for four hours, the precipitate formed has the constant composition $PO_5. 24MoO_3. 3NH_4O. 3H_2O$. The separation is complete and the precipitate does not pass through the filter if it is first washed with dilute molybdic solution and then with pure water. It is dried and weighed and the per cent of phosphoric acid calculated from the above formula.

In presence of iron and alumina the results by this method are not exact. In this case the precipitate is dissolved in ammonia, tartaric

acid added, and the phosphoric acid precipitated as ammonium-magnesium phosphate.—W. H. B.

On the determination of fat in bread, M. WEIBULL (*Svensk kemisk Tidskrift, 1892, No. 5*).—The author found in an investigation that bread contained less fat than the flour from which it was made. This he shows to be due to an error of analysis, direct extraction with ether giving too low results in case of bread, no matter how long the extraction is continued. The starch and dextrin of the bread inclose the fat and prevent the action of the ether. To obviate this difficulty the author proceeds in the following manner:

From 1 to 3 grams of dry pulverized bread is boiled for an hour with 15 to 20 c. c. of water and 10 drops of dilute H_2SO_4, stirring occasionally with a glass rod. The solution is then completely neutralized with fat-free powdered marble (an excess will do no harm) and the thick solution transferred to a piece of fat-free filter paper, such as is used in milk analysis, the beaker being wiped out with absorbent cotton. The paper and cotton are heated at 100° C. for two or three hours, and then extracted with anhydrous ether in an extraction apparatus for ten hours. Parallel determinations by this method agree perfectly, and comparative analyses of fat in flour and in the bread made from the same give concordant results.—F. W. W.

The water-soluble combinations of phosphoric acid in superphosphates, J. STOKLASA (*Landw. Vers. Stat., 42 (1893), No. 6, pp. 439–457, plate 1*).—This is a continuation of work already reported on in the same journal, vol. 38, pp. 197, 401 (E. S. R., vol. II, pp. 611, 757), and relates to the influence of calcium salts on superphosphates. The author shows that on mixing calcium carbonate with monocalcium phosphate in the proper proportions the following reactions occur:

(1) $CaH_4(PO_4)_2.H_2O+CaCO_3+2H_2O=2CaHPO_4.2H_2O+CO_2$;

(2) $CaH_4(PO_4)_2.H_2O+2CaCO_3=Ca_3(PO_4)_2.2H_2O+2CO_2+H_2O$;

that is, either dicalcium or tricalcium phosphate are formed. The formation of dicalcium phosphate by the action of orthophosphoric acid on calcium carbonate was pointed out by H. Ritthausen in 1877, but the second reaction—the formation of tricalcium phosphate—has not heretofore been clearly understood.

The importance of these reactions from an agricultural standpoint is explained at some length.

A review of the detailed accounts of fertilizer experiments shows no accurate data as to the composition of the superphosphates used in such experiments, especially as to the amount of free phosphoric acid and monophosphates (of calcium, magnesium, iron, and aluminium) they contained. The author states that for this reason all previous experiments in this line have been incomplete, and that the deductions from them do not possess the value commonly attributed to them. In order, therefore, to obtain more accurate data on the subject he carried out a number of experiments with monocalcium phosphate, both in

solid form and in solution, mixed with calcite or limestone, with free phosphoric acid, etc. These and similar experiments lead to the conclusions that calcium carbonate forms less triphosphate out of dilute solutions than out of concentrated solutions; that the energy of the decomposition of calcium carbonate depends upon the concentration of the monophosphate solutions, and the amount of triphosphate formed is determined by the same factor; and that the circulation of monocalcium phosphate solutions is dependent upon their concentration, dilute solutions circulating much more rapidly in calcareous soils than concentrated.

Experiments in which orthophosphoric acid was substituted for the monophosphate showed that the absorption of this substance increased with the concentration of the solution.

Experiments to determine the depth to which the soluble phosphates would sink unaltered in different kinds of soil are described, as well as others to observe the circulation and decomposition of phosphates in the principal constituents of soils (sand, calcium carbonate, clay, and humus), and the absorptive power of different soils. The apparatus used in the latter experiments are described and illustrated.

These experiments show, in general, that as soon as the monophosphate in superphosphates comes in contact with the water in the soil decomposition sets in, which, in the presence of calcium carbonate, results finally in the transformation of a large proportion of the monophospate into triphosphate.—W. H. B.

Comparative investigations on the weight and the specific gravity of the different peas in a pod, S. M. ANDRÉE (*Allm. Svenska Utsädesför. Tidskrift, II (1892), pp. 132–144*).—The author selected 600 pods from dried pea vines, 100 containing two peas each, 100 containing three peas each, etc. They were arranged in groups and subgroups according to the number and position of the peas in the pod, the one nearest the stem being designated as number one. The peas were weighed on two occasions, with an interval of some days, and the average taken as their weight. Tabular information is given showing the average weight of the peas in each group. The lightest peas were always found near both ends of the pod. The average weight of a pea in a pod was greater the larger the number of peas in the pod, so that the largest pods contained the heaviest peas. The weight of the peas next the point of the pod increased with the increased number of peas in the pod. With the exception of the first and last peas there was but a very small difference in the weight of the peas in the same pod.

The specific gravity determinations were made with distilled water by means of a picnometer and corrections made for temperature. The results obtained were, in general, comparable with those found for the weights, but the author thinks that in practice in selecting seed no attention need be paid to the specific gravity.—F. W. W.

The influence of soil moisture on plants, E. GAIN (*Bul. Soc. Bot. France, 40 (1893), No. 2, pp. 142–144, and No. 3, p. 145*).—The author conducted a series of experimental cultures to ascertain the effect of soil moisture on the anatomical structure of plants. The species grown were *Lupinus albus*, *Papaver somniferum setigerum*, *Polygonum fagopyrum*, and *Helianthus tuberosus*. The plants were grown in pots and the amount of moisture regulated so as to be constant. One lot was grown in soil containing only a very limited amount of moisture, and the other in soil nearly saturated. The observed differences are tabulated for the *Lupinus* and the *Papaver*, the others not differing in any essentials from them. The parts examined were the petioles of the lupine and the peduncles of the poppy, *Polygonum*, and *Helianthus*.

The author's conclusions, based upon some rather striking tabular matter are: The adaptation of plants to their very different soil conditions is retained in their anatomical structures even to the extremity of their aërial stems. This adaptation in the case of the above mentioned studies may be characterized as follows: (*a*) The number of fibrovascular bundles is most numerous in plants grown in dry soil; (*b*) the number of vessels in each bundle is less in the dry-soil plants; (*c*) the development of sclerenchyma is often very important toward the outer part of the fibrovascular bundles in the moist soil plants; (*d*) the production of collenchyma is often very thick and continuous in plants grown in very dry soil.

In the plant grown in dry soil the conducting vessels are scattered, assuring a better circulation throughout the plant, while in the plant grown in moist soil they are protected externally by a supporting sclerenchyma which prevents injury to the turgid stem from bending on account of its great length.—W. H. E.

The nitrogen compounds contained in meteoric waters, A. PETERMANN and J. GRAFTIAU, (*Bul. Sta. Agron. Gembloux, No 52, July, 1893, pp. 5–26*).—This is the second part of a report on researches on the composition of the atmosphere, carried on for many years, the first part of which related to the carbonic acid of the atmosphere.*

The meteoric waters (rain, snow, and frost) were collected during the period from January 1, 1889, to December 31, 1891, and analyzed whenever a sufficient amount was obtained to permit of it. In other cases determinations were made at intervals of variable length. The results of 141 determinations of ammoniacal, nitric, and nitrous nitrogen are tabulated and illustrated in a diagram. The following conclusions are drawn:

The meteoric waters obtained at Gembloux contained, on the average, 1.49 mg. of combined nitrogen per liter, which, for a precipitation of 692 mm., corresponds to 10.31 kg. per hectare annually.

In 100 parts of total nitrogen there are 76 parts of ammoniacal nitrogen, and 24 parts of nitric and nitrous nitrogen. The amount of

*Mem. Acad. Roy. Belgique, 47, 1892.

nitrogen in the form of carbonate of ammonia is therefore greater than that in the forms of nitrate and nitrite of ammonia.

The composition of the meteoric waters varies with each rainfall from month to month and from year to year. Their richness depends especially on the amount of the precipitation, and this factor also determines the amount of nitrogen compounds supplied to the soil. The average richness of the waters begins to decrease during the month of April, reaches its minimum in June and July, and attains its highest point in February. This may be explained by the fact that gentle precipitations (mist) and precipitations in the form of frost and snow are much richer than rain, reaching occasionally five times the general average of the latter.

Meteorological observations covering only the visible phenomena of storms are insufficient to establish any relation between the electrical condition of the atmosphere and the richness of rain water in oxides of nitrogen.—W. H. B.

Experiments with cow urine and liquid manure at Dalum Agricultural College (Denmark), 1889-'92, N. A. HANSEN (*Tidsskr. Landökon., 12 (1893), pp. 424-478*).—*Examination of cow urine.*—The urine from 12 cows in the college herd was carefully collected, weighed, and sampled once every month for a year, from September, 1891, to September, 1892. A record was kept of the food eaten and the milk produced during this period. The cows used were in milk nearly all the time and were at different stages of the period of lactation. The following table gives the average figures obtained in the investigstion:

Milk, excrement, and food of twelve cows, 1891-'92.

Date.	Milk yield.	Solid excrement.	Urine.	Nitrogen in urine.	Food per cow daily. Mangel-wurzels.	Hay.	Straw.	Sugar-beet pulp.	Conc. feeds.
Seven winter months.	*Pounds.*	*Pounds*	*Pounds.*	*Per ct.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
October 30, 1891	25.0	66.4	18	0.817	70	5.0	8	....	6.0
December 1, 1891	27.9	50.7	15.3	1.027	60	2.0	8	30	6.5
December 30, 1891	22.9	49.2	12.1	1.391	70	2.0	8	....	7.5
February 2, 1892	18.4	43.4	14.2	1.184	50	0.17	8	....	7.25
March 2, 1892	17.2	42.2	11.2	1.575	50	0.17	8	....	7.25
March 30, 1892	15.7	40.6	11.8	1.406	50	0.17	8	....	7.25
April 29, 1892	11.6	47.0	11.5	1.466	30	0.33	8	....	8.0
Average	19.8	48.5	13.5	1.224	54.3	1.41	8	4.3	7.11
Five summer months.								Soiling crops.	
June 1, 1892	15.2	45.3	24.2	0.929	....	1.5	4	43	4.33
June 29, 1892	19.0	63.2	20.2	0.979	....	6.0	0.5	55	4.33
August 2, 1892	22.8	56.5	32.5	1.114	....	6.0	....	58	4.42
September 2, 1892	26.2	48.0	22.5	1.253	....	6.0	5.0	63	5.00
October 2, 1892	25.7	53.2	18.4	1.102	44	6.0	6.0	16	5.00
Average	21.8	53.3	23.6	1.077	8.8	5.1	3.1	47	4.42
Average for whole year	20.6	50.5	17.7	1.142	....	....	....	....	....

The soiling crops fed during the summer months were made up of green grass during May, green grass and green clover during June, green clover, vetches, and yellow mustard during July, lucern and buckwheat during August, and mangel-wurzels during September.

The data show that the quantity of urine excreted and its composition are greatly dependent on the food and also upon the season. Less urine was voided during the winter than during the summer, in spite of the fact that roots were fed liberally in winter. It is also noticeable that where the roots were decreased from 70 to 50 pounds (December 30 to February 2) the average quantity of urine increased from 12.1 to 14.2 pounds per cow per day, and the further decrease to 30 pounds of roots during April did not diminish the excretions of urine.

The cows voided three and one half times as much solid as liquid manure while on winter feed, and two and one fourth times as much while on summer feed. During the year 18,431 pounds of dung and 6,454 pounds of urine were voided per cow.

The following table shows the distribution of nitrogen in feed, milk, and urine, and the proportion of nitogen recovered in the urine:

Nitrogen in food, milk, and urine.

	Nitrogen in—			Proportion of nitrogen in food recovered in urine.	Proportion of nitrogen in food less that in milk, recovered in urine.
	Food.	Milk.	Urine.		
	Pounds.	*Pounds.*	*Pounds.*	*Per cent.*	*Per cent.*
Total for year	193.97	45.19	73.72		
Total for seven winter months	110.71	25.31	35.08		
Total for five summer months	83.26	19.88	38.64		
Average per month for winter months			5.01	32	41
Average per month for summer months			7.73	46	61
Average per month for year			6.14	38	49

The percentage of potash and of phosphoric acid in the urine were determined every third month. The liquid manure, which often had been in contact with the dung and drained into the urine cistern of the stable, was also sampled and analyzed, with the following results:

Analysis of cow manure and liquid manure.

	Cow urine.					Liquid manure from stable.						
	Spring.	Summer.	Autumn.	Winter.	Average.	Jan., 1889.	Dec., 1889.	Dec., 1890.	April, 1891.	Oct., 1891.	April, 1892.	Average.
	Pr. ct.	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*
Nitrogen	1.482	1.007	1.057	1.201	1.187	0.441	0.328	0.469	0.491	0.384	0.441	0.426
Potash	1.131	1.279	1.413	1.181	1.272	0.454	0.356	0.350	0.519	0.405	0.365	0.438
Phosphoric acid	0.055	0.009	0.012	0.024	0.021	0.012				0.011	0.027	0.017

Experiments in preserving liquid manure.—Six experiments are reported in keeping liquid manure in a small tight cistern made of stone and lined with cement and asphalt. The liquid manure was kept

in the cistern from one to six months at a time. In all, 18,107 pounds of liquid manure was placed in the cistern and 17,996 pounds taken out, a loss of 111 pounds. The nitrogen decreased from 84.29 pounds at the beginning to 80.88 pounds at the end, and the potash from 39 pounds to 38.95 pounds. The average loss per month was 0.3 per cent of liquid manure, 1.7 per cent of nitrogen, and 0.1 per cent of potash.

Field experiments with liquid manure.—Experiments with liquid manure for grass land and mangel-wurzels were conducted during 1889–'92. In the experiment on grass land 34½, 51½, and 69 barrels of liquid manure per acre were applied in October, December to January, and April, respectively. In all cases but one the yields of hay per 100 pounds of nitrogen applied were larger with the larger applications in which the liquid manure was sprinkled over the land during December and January. It was found better, where practicable, to keep the manure over winter and apply it in the spring.

Liquid manure which had been kept for some time (one to six months) in the cistern was compared with fresh manure in a number of experiments. In every trial the yield of hay was relatively larger where old liquid manure was applied. Analyses show that the old liquid manure contained less nitrogen, ammonia, and phosphoric acid, but more potash than the fresh liquid manure.

As to the best time to apply manure in summer, the best results with grass and with root crops were obtained when the liquid manure was applied in April or in July (for roots). "The liquid manure intended for grass land ought generally not to be kept long after April 1, but ought to be distributed as it accumulates." For mangel-wurzels the highest yields were obtained in applying the manure in July, with April coming next. It is possible that the better results during July are wholly or partly due to the greater potash content of summer urine.

As regards the manner of applying the liquid in the root field during the growing period of the roots, the result of three years' work shows plainly that liquid manure should be distributed only between the rows, and that the later during the summer the manure is applied the relatively poorer the results obtained from distributing it over the whole field. The author describes delivery tanks constructed for the purpose of applying the liquid manure between the rows.—F. W. W.

Experiments in manuring meadows, EDLER (*Braunschw. landw. Ztg., 61 (1893), No. 41, pp. 175, 176*).—In four localities in the Harz Mountains, Germany, experiments were conducted to determine the most profitable commercial fertilizers for meadows. In three of the experimental fields, representing three classes of soil, the number of plats was 20. The fourth experimental field, where only 15 plats were used, had to be abandoned on account of imperfect drainage. Prior to the first manuring the yield of hay on each plat was determined and the plats were then so grouped that the average productiveness of the plats devoted to each fertilizer was practically the same.

Lime, kainit, ground Thomas slag, and nitrate of soda were used singly and in combination, at the rate of 1,600 pounds of lime per acre, 480 pounds of kainit, 400 pounds of slag, and 160 pounds of nitrate of soda. These fertilizers were applied in the fall.

For four years, 1886 to 1889, inclusive, the applications were repeated annually on the same plats. During the next three years, 1890 to 1892, no fertilizers were applied, and the residual effects of the different fertilizers on the hay crop were thus determined.

The following table gives the average results in the three localities for the four years when the fertilizers were applied annually, reckoning the yield of the unmanured plats at 100:

Effect of fertilizers on the yield of hay.

	At Bremerhöhe.	At Einersburg.	At Roland.
Unmanured	100	100	100
Lime	105	108	108
Kainit	120	116	112
Thomas slag	99	105	102
Lime and kainit	125	127	133
Lime and Thomas slag	104	110	110
Kainit and Thomas slag	148	136	134
Lime, kainit, and Thomas slag	131	134	136
Lime, kainit, Thomas slag, and nitrate of soda	159	160	163

The above table shows the favorable effect of kainit, either alone or in combination with Thomas slag. With kainit at 30 cents per 100 pounds, Thomas slag at 42 cents, lime at 14½ cents, and nitrate of soda at $2.76, a mixture of kainit and Thomas slag gave the largest net profit, followed by kainit alone, and then by a mixture of kainit and lime. No other application was profitable.

The favorable residual effect of a mixture of kainit and Thomas slag was apparent during the years 1890–'92, when no application of fertilizers was made.—J. F. D.

Influence of the size of grains of seed wheat on the yield of the resulting crop, F. DEPREZ (*Jour. Agr. Prat., 57 (1893), No. 41, pp. 503–505*).—At the experiment station of Cappelle large grains from both the middle and the extremity of the ear were compared with small grains from the same parts of the ear as to their relative values for seed. The comparison of large and small grains was repeated on three varieties of wheat, using seed from the ears ripening earliest and from those ripening latest. The seed was carefully sown at a distance of 20 centimeters (8 inches) each way, the drills sown with large grains alternating with those sown with small grains. For the crop of 1892 all seed grains were from the middle of the ear; in 1893 seed from the middle and extremity of the ear was used. The results for both years appear in the following table:

Yield of wheat per hectare from large and small grains of seed.

	From large grains.	From small grains.	Difference in favor of large grains.
1892.	*Kg.*	*Kg.*	*Kg.*
Variety No. 1:			
Early ears, middle	5,726	4,799	927
Late ears, middle	6,172	4,235	1,937
Variety No. 2:			
Early ears, middle	5,231	3,123	2,108
Late ears, middle	4,680	2,456	2,224
Variety No. 3, early ears, middle	5,879	3,543	2,336
1893.			
Variety No. 1:			
Early ears, middle	5,835	5,769	66
Early ears, extremity	5,492	4,425	1,067
Late ears, middle	5,869	4,347	1,522
Late ears, extremity	5,291	4,491	800
Variety No. 2:			
Early ears, middle	5,142	5,035	107
Early ears, extremity	5,587	5,242	345
Late ears, middle	6,330	4,543	1,787
Late ears, extremity	4,897	4,393	504
Variety No. 3, early ears, middle	6,365	6,161	204

In every case large seed gave a heavier yield of grain than small seed. The yield of straw was also greater from the use of large grains, except in one case.

The author draws no conclusion as to the relative value of the earliest and latest ears of wheat or grains from the middle and from the extremity of the ear as sources of seed wheat.—J. F. D.

On the germination of Ricinus, L. SABLON (*Compt. Rend.*, *117* (*1893*), *No. 16*, *pp. 524–527*).—The author has made a study, from a chemical point of view, of the modifications produced during the germination of the seed of *Ricinus*. The chemical composition of the seed is, according to Husemann, water 6 per cent, nitrogen 19 per cent, fat 66 per cent, soluble carbohydrates 3 per cent, fiber 2 per cent, and ash 3 per cent. The author's investigations were on the variation of the fats, fatty acids, and glucose. He has determined the different stages of germination by the length of the radicle, on the ground that the chemical phenomena observed in a sprouting seed is proportional to the state of development of the plant rather than the duration of the period of germination.

The following table shows how the oil content diminishes in the albumen and plantlet in proportion to the increased length of the radicle:

Analysis of germinating seed.

Length of radicle.	Albumen. Weight of dry matter.	Albumen. Weight of oil.	Albumen. Per cent of oil to dry matter.	Plantlet. Weight of dry matter.	Plantlet. Weight of oil.	Plantlet. Per cent of oil to dry matter.
Cm.	*Grams.*	*Grams.*		*Grams.*	*Grams.*	
0.0*	2.980	2.054	69			
0.7	1.910	1.280	67	0.116	0.076	45
1.3	2.069	1.223	59	0.189	0.038	20
4	3.020	1.344	44	0.636	0.113	17
5	1.836	0.667	36	0.589	0.080	13
6	1.297	0.310	24	0.662	0.061	9
8	1.615	0.364	22	0.830	0.070	8
10	1.228	0.253	20	0.680	0.066	9
12	1.261	0.135	11	0.840	0.060	7

* Albumen and embryo.

The above table shows a constant decrease in the oil content of the albumen until it reaches about 10 per cent at the end of germination, that is, when the cotyledons have emerged from the albumen. It also shows a constant decrease in the oil content of the plantlet to about 8 per cent.

The fatty acids were examined and their amount estimated by the quantity of soda required to neutralize them. In the albumen the quantity increased somewhat irregularly with the germination. In the plantlet the maximum was reached when the radicle was a little less than 1 cm. in length. The author was not able to decide positively on the presence of glycerin. Glucose existed in very small quantities in the albumen of the seed, but increased rather rapidly during germination, as is shown by the following table:

Glucose in germinating seed.

Length of radicle.	Weight of dry matter.	Glucose.	Per cent of glucose to dry matter.
	Grams.	*Grams.*	
0.0*	2.302	0.010	0.4
1.5 centimeters	1.953	0.064	3
2.0 centimeters	1.784	0.130	7
4.0 centimeters	2.000	0.210	10
8.0 centimeters	1.615	0.222	13
10.0 centimeters	1.228	0.175	14

* Whole seed, i. e., albumen and embryo.

When the albumen and plantlet are both considered, as much as 20 per cent of glucose is sometimes found. From this it would seem that the glucose is provided more or less directly by the transformation of the oil, and the content of one diminishes as the other increases.

The author has investigated the decrease of the oil content and the increase of the glucose in artificial conditions and finds practically the same results as previously given.

He compared the isolated albumen of germinating seeds with that still connected with the embryo and found the change took place faster in the isolated albumen than in the normally germinating seed.—W. H. E.

Weeds of Ontario, J. H. PANTON (*Ontario Agr. College Bul. No. 91, Nov. 15, 1893, pp. 7, figs. 4*).—Replies to the author's inquiries give the following twenty-five as the worst weeds in Ontario: Canada thistle, wild mustard, wild oats, oxeye daisy, burdock, couch grass, ragweed, wild peas, cockle, dock, redroot, bur, wild flax, foxtail, pigweed, black bindweed, milkweed, sorrel, purslane, blueweed, mullein, mayweed, lamb's quarters, sow thistle, and bindweed. The species are given in the order of their relative badness. Descriptions and illustrations are given of penny cress (*Thlaspi arvense*), tumbleweed (*Sisymbrium sinapistrum*), wild carrot (*Daucus carota*), clotbur (*Xanthium canadense*), and dodder (*Cuscuta trifolii*). These weeds are becoming established and the public is warned against them. A systematic list of 92 species of weeds representing, 76 genera and 28 orders, is given, together with information as to the period of their duration.—W. H. E.

The propagation of pourridié of the grape through cuttings and scions packed in layers of sand, A. PRUNET (*Comp. Rend., 117 (1893), No. 17, pp. 562–564*).—The author calls attention to the usual practice of packing cuttings and scions of grapevines in layers of sand, either when intended for shipment or to be kept for a time until planted or grafted. The sand protects them and prevents the growing of buds or roots, but the lack of air and unavoidable presence of some moisture makes it a favorable place for the development of fungi.

Viala has already shown* that *Sclerotinia fuckeliana* is propagated in this way and when the sclerotia of the fungus come between the contact surfaces of graft and stock they prevent their union.

Specimens of young vines were submitted to the author which had been grafted in the spring of 1892 and which were plainly affected in some way. The author found the subterranean portion of the stock nearly covered with a thick mat of uniform brown mycelial filaments, the characters of which agreed with those of *Dematophora glomerata*, the cause of pourridié in sand or sandy soil. The later observation of the conidiophores confirmed the determination that the fungus was *Dematophora glomerata*. An investigation showed that the stock of the vine had remained for a long time before planting in a dark, damp cellar, in sand which had been used for many years for the storing of grafts, cuttings, and rooted plants. The cuttings and some rooted plants had doubtless carried the *Dematophora* to the sand at some previous time and it was still being propagated and distributed by means of the cuttings placed in it. The author thinks that unconsciously in this way the disease is spread to regions and vineyards not infected.

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*Rev. gen. Bot., 3 (1891), p. 145.

The sand in which cuttings and grafts were received was examined at the request of a number of viticulturists and among the débris were evidences of the presence of *Dematophora glomerata.* It had already caused the disease in two vineyards. In three other cases were found *Rœsleria hypogea,* thought to be another cause of the pourridié. The most serious feature of this disease is that the affected plants will surely die and will for a long time inoculate the soil. In order to prevent the propagation and distribution of these diseases of grafts and stock the author suggests the following precautions: Sand intended to receive cuttings, scions, or rooted plants should be clean, aired, and not too damp; it should be stored under a shed with a north exposure; its humidity should not be permitted to exceed 10 per cent; no cuttings or plants not used should remain in the sand indefinitely; and it should be heated every year in an oven to sterilize it, or, where this is not practicable, during the heat of summer it should be exposed on some level place to the air and sun, and frequently stirred.—W. H. E.

The Peziza of mummified quince fruits, E. PRILLIEUX (*Bul Soc. Bot. France, 40 (1893), No. 3, pp. 219, 220*).—The author has been for some time studying the disease of quince leaves. Specimens from one of the provinces submitted to him were covered with a white powder, the spores of a *Monilia,* which was determined as *M. linhartiana,* already reported from Hungary as living on the leaves of *Prunus padus,* and in Italy on the leaves of the quince and service tree, and described and figured by Briosi and Cavara as *Ovularia necans.*

The author reports the abortive and mummified fruits of the quince as very abundant, while their leaves were covered by the *Monilia* fructification. The filaments of the fungus mycelium had forced their way through the tissues, making a compact mat. Specimens were exposed in pots near the laboratory, where in winter they were often covered with snow. Toward the middle of March the fruits were covered with the apothecia of a *Peziza* whose spores germinated readily in moist air, producing germination tubes somewhat similar to those shown by Woronine as of the *Peziza* of *Vaccinium* fruits. The young leaves of the quince were inoculated and the disease readily produced. The resemblance of the fungus to *Sclerotinia padi* and *S. aucupariæ* is quite marked. The author thinks this disease quite different, however, and has described it under the name *Peziza linhartiana.*—W. H. E.

A new enemy of the vine (Blanyulus guttulatus), M. FONTAINE (*Compt. Rend., 117 (1893), No. 16, pp. 527,528*).—Last April the author planted non-rooted cuttings of four American varieties of grapes. The cuttings were sunk as far as the upper bud in the soil and everything was done to contribute toward their successful growth. The sprouts appeared very irregularly here and there throughout the nursery. The author uncovered the plants to find the cause of their behavior. Those which showed no signs of life were dug up and small

myriapods were found, 5 to 10 for each sprout, forming regular knots of about the size of a small pea. All parts underneath the soil were equally attacked. Some of the young shoots were attacked by these pests, and tunnels extending many centimeters into the interior of the branches were observed. The author collected as many as possible and in that way saved part of his plantation. The determination as *Blanyulus guttulatus* was made by F. Henneguy, of the College of France. This myriapod is a well-known enemy of strawberries, salad, and other tender plants, but this seems the first report of its attacking the grape.

Watering with a solution of sulpho-carbonate of potassium, or the application of sulphur to the soil before planting, will prove beneficial in reducing the number of the myriapods.—W. H. E.

Effect of salt on the digestion and exchange of albuminoids, S. GABRIEL (*Ztschr. Biol., 29, No. 4, pp. 554–569*).—The author prefaces the account of his experiments with a résumé of the investigations on this subject which indicates that the action of salt is only imperfectly understood.

Two separate experiments are reported, each with two sheep. These were fed hay to which 10 and 30 grams of salt, respectively, per head daily was added in two periods of about a week each. In some cases the rate of digestibility of the nitrogen was slightly higher when salt was fed, and in others there was no effect. In one case an after effect of the salt seemed apparent. In each case individuality bore a prominent part.

As to the effect of salt on the breaking down of the albuminoids of the body, the results with different animals are at variance. When it is remembered that Voit and Weiske found that salt increased the nitrogen exchange, while in the majority of cases in these experiments and Dubelier's experiments a decrease of the exchange is apparent, and that in one case no action was apparent, the only sure conclusion is that the action of salt is not the same under all conditions. The data thus far secured do not establish any connection between the action of salt on digestibility or exchange of nitrogen, the diuretic action, the amount given, and the manner of feeding. It may all be a matter of individuality.—E. W. A.

The digestibility of rations when fed in one and in several portions, H. WEISKE (*Ztschr. physiol. Chem., 18, No. 2, pp. 109–111*).—The author reports experiments in which like amounts of the same ration were fed in a single portion and in several separate portions, and the digestibility was determined. A sheep fed on a ration of hay and oats digested the following percentages of the nutrients:

Percentage of nutrients digested by sheep.

Manner of feeding.	Protein.	Fat.	Cellulose.	Nitrogen-free extract.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Fed in one portion	58.12	78.26	36.06	77.97
Fed in four portions	62.20	82.40	33.80	76.34
Difference	+4.08	+4.14	—2.26	—1.63

The explanation offered for the better digestion of the protein and fat when fed in four portions is that in consuming the food in small portions the digestive juices were able to act more thoroughly and more intensely on the food.

Experiments are also reported with rabbits fed different total amounts of food per day. The results follow:

Percentage of nutrients digested by rabbits.

Food given daily.	Protein.	Fat.	Cellulose.	Nitrogen-free extract.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
93.5 grams of oats	66.8	93.6	19.6	67.9
84.5 grams of oats	81.3	94.7	10.4	84.2
52.0 grams of oats	92.6	93.1	34.7	86.5

With respect to most of the nutrients the percentage digested increased as the amount fed diminished.—E. W. A.

The value of asparagin in the nutrition of herbivorous animals, H. WEISKE (*Ztschr. Biol., 30, No. 2, pp. 254–278*).—Experiments with herbivora, rats, dogs, and pigeons, by a number of different investigators, have tended to show that while asparagin was not equivalent to the albuminoids in performing the functions of nutrition, it possessed a certain value for conserving the albuminoids, especially in a ration relatively poor in albuminoids and rich in carbohydrates.* Under such conditions its addition to the ration enabled a storing of albuminoids in the body which had not taken place on the basal ration; and again, it was used to replace a part of the albuminoids in the ration of milch cows without any perceptible effect on the live weight or milk production.

The author points out that this conserving action of asparagin must not be considered the same as that attributed to carbohydrates. Both may favor the storage of albuminoids in the body, but while the conserving action of the carbohydrates takes place when added to a ration rich in albuminoids and having a narrow ratio, but not in a ration already rich in carbohydrates and poor in albuminoids, the conserving action of asparagin, on the other hand, is manifest in a ration poor in albuminoids and having a wide ratio.

* For résumé and account of earlier experiments by the author, see E. S. R., vol. II, p. 530.

For instance, a ration of potatoes and straw or hay and starch fed to herbivorous animals is not fitted for production. The addition of starch does not improve such a ration, but makes the matter worse. The addition of albuminoids, or of asparagin, improves such a ration and is followed eventually by the storage of nitrogen in the body.

The author reports a trial with five rabbits, all of the same litter, and about seven months old. Two of the lot (Nos. 1 and 3) were killed at the beginning of the trial, and the teeth, bones, and flesh partially analyzed. The three remaining were fed as follows: No. 2, nitrogen-free food exclusively; No. 4, the same food, except that a part was replaced by a like amount of asparagin; and No. 5 the same as No. 4, except that fibrin was fed in place of asparagin. Each animal was kept in a separate pen lined with tin.

As a rule No. 2 (carbohydrates) ate its food most eagerly when the day's ration was given, while the others ate theirs more gradually through the day. In six weeks' feeding the weight of No. 2 diminished from 2,430 grams to 1,465 grams. It was then so weak and nearly dead that it was killed. It had lost 965 grams, or 40 per cent.

No. 4 (carbohydrates and asparagin) thrived well for the first three weeks, and after that gradually diminished in weight and lost its appetite, so that it was killed at the end of eight weeks. It had lost during the trial 690 grams, or 30 per cent.

No. 5 (carbohydrates and fibrin) lost 310 grams in eight weeks, or 14.7 per cent.

Nos. 4 and 5 were killed, and, together with No. 2, analyzed the same as the two killed at the beginning. The data show that the weights and the flesh, fat, and nitrogen were much lower in the case of No. 2 than No. 4, indicating that the asparagin and carbohydrates had been a far more advantageous food than the carbohydrates alone. No. 4 fell considerably behind No. 5 (carbohydrates and fibrin) in all respects except the amount of fat, which was nearly the same for both, indicating that for fat production asparagin was nearly equal to fibrin.

The excreta from all the rabbits gave a reaction for starch, and, after treatment with hydrochloric acid, for sugar, although the reactions were weak in the case of Nos. 4 and 5. The feces of all three animals contained about the same amount of nitrogen, which in the case of No. 2 (carbohydrates) must have been derived principally from the metabolic products, digestive fluids, mucin, epithelium, etc. The feces of No. 2 contained considerably less undigested crude fiber but much more carbohydrates than those of Nos. 4 and 5. From the figures showing the percentages digested it appears that No. 2 did not digest the carbohydrates as nearly completely as Nos. 4 and 5. While the last two voided only about 2 grams per day undigested, No. 2 excreted more than twice that amount. The author concludes from this that asparagin, like albuminoids, under favorable conditions may favorably influence the

digestion of starch; and that this may have some connection with a previous observation of his that asparagin may modify the depression in digestibility of albuminoids noticed when an excessive amount of carbohydrates is fed.

Two other experiments were made with rabbits on the same plan as the one described above. In both cases the rabbits on carbohydrates alone ate their food the most ravenously. The feces of the rabbits fed carbohydrates alone contained somewhat more undigested crude fiber and in the second trial more undigested carbohydrates. With respect to the carbohydrates the results of the last trial differed from those of the other two, since the amount of undigested carbohydrates voided was practically the same for all the rabbits. It is suggested that, as the animals used in this trial were considerably larger, the allowance of starch fed may have been so small that it was digested as completely as possible without the aid of asparagin, so that there was no opportunity for the asparagin to show a favorable action.

In view of all the results obtained in these three trials the author considers it highly probable that under favorable circumstances the addition of asparagin to the food may exert a favorable influence on the digestion of starch. But the favorable effect of asparagin in the ration can not be accounted for solely by its action in the digestion of the nitrogen-free extract, since the first experiment, as well as others, has shown that animals fed on carbohydrates alone decrease in weight much faster than those fed asparagin, in spite of the fact that the former receive and digest more starch than the latter. It is considered probable that the favorable effect of asparagin is due rather to its ability to economize the albuminoids of the body, as pointed out at the beginning of the article.—E. W. A.

The digestion and assimilation of the albuminoids of the food as related to the composition of the ration, E. KRAUSS (*Ztschr. physiol. Chem.*, *18*, *No. 2*, *pp. 167–180*).—The utilization of the albuminoids of a food material has commonly been estimated on the basis of the ability of the intestines to resorb the nitrogeneous digestion products. The nitrogen voided in the dung and the nitrogen-content of the urine furnished the basis for judging of the nitrogen assimilation and the nitrogen exchange of the body. The urea in urine has been supposed to be principally derived from the peptonized albuminoids of the food resorbed in the intestines, or an amount equivalent to this derived from the breaking down of certain amounts of albuminoids in the body. As is well known, the digestion of the albuminoids with trypsin and especially the fermentation in the intestines, result in decomposition products lower than soluble albuminoids and peptones. Among these are leucin, tyrosin, aspartic acids, indol, skatol, ammonia, and phenols. These amido-acids and aromatic bodies are resorbed in the intestines. It is not known that a reformation from these products of bodies similar to peptones or albuminoids takes place, and

it is very generally believed that while the albuminoids of the body can be replaced by peptones, they can not be replaced by amido-acids or aromatic bodies. Hence in determining the resorption of albuminoids it is of prime importance to know whether the albuminoids are taken up in the form of peptonized albumen or as its lower decomposition products.

While the amount of urea excreted furnishes an indication of the total amount of albuminoids decomposed in the intestines, it shows nothing with certainty concerning the amount of albuminoids resorbed as such, since from the total amount must be subtracted the amount of decomposition products resulting from the action of trypsin and fermentation processes. It is not possible to determine the latter directly with certainty, although it can be estimated indirectly.

It appeared to the author of interest to determine whether carbohydrates actually diminish the fermentation of the albuminoids in the intestines, as investigations by Hirschler * have indicated to be the case. Accordingly, he starved a dog for six days, fed him 500 grams of meat per day for six days following, and then added 500 grams of white bread per day to the 500 grams of meat for six days longer. In the two periods when food was given determinations were made of the ("*gepaarter*") sulphuric acid and the indol in the urine, as furnishing approximate indications of the aromatic bodies resorbed and the activity of the albuminoid fermentation, respectively. The nitrogen in the urine was also determined, and occasionally the urea.

The results in the two periods in which food was given showed that the daily excretion of indican and ("*gepaarter*") sulphuric acid was much larger on the meat, indicating that the fermentation had been much more intense on the meat ration, and that the amount of albuminoids resorbed as peptone must have been smaller on the meat than on the bread and meat. The indications are that the albuminoids were better utilized when bread was fed with the meat than when meat was fed exclusively. The more advantageous use of the nitrogen was not due to a more advantageous use of the vegetable albuminoids in the bread, for Rubner † found that the nitrogen in white bread was utilized only in a small degree. The only logical conclusion, then, is that the addition of carbohydrates effected a more thorough utilization of the nitrogen in the meat and diminished the fermentation and decomposition of the albuminoids in the intestines.

The fact that a larger deposition of nitrogen in the body may accompany the addition of carbohydrates to the food, even when less protein is fed, has been noticed by other investigators, namely, by Rubner,‡ Munk,§ and Kumagawa. ||

*Ztschr. physiol. Chem., 10 (1886), p. 306.

† Ztschr. Biol., 15, p. 115.

‡ Ibid, 15, p. 146.

§ Virchow's Arch. path. Anat. and Physiol., 101 (1885), p. 107.

|| Ibid, 116 (1889), p. 370.

The investigation casts some light on the question of feeding standards for man and animals, and indicates the waste of valuable nutrients which may result from the improper combining of food materials.—E. W. A.

Effect of decoctions of tea and coffee on artificial digestion, C. SCHULTZ-SCHULTZENSTEIN (*Ztschr. physiol. Chem., 18, pp. 131, 132*).—Boiled egg was chopped into millimeter cubes and separate amounts digested in 30 c. c. of artificial digestion solution containing 0.16 per cent of hydrochloric acid for eight hours at 37.5–39° C. One portion was digested with the digestive solution alone; and in other cases there was added to this 10 c. c. of tea, 10 c. c. of coffee, and 10 c. c. of pure distilled water, respectively, the object of the water being to control the effect of the dilution of the digestive solution on the digestion. The tea was made with 100 c. c. of water and 6 grams of black tea, and the coffee with 100 c. c. of water and 12 grams of roasted coffee. The results follow:

Percentage of albumen in boiled egg digested by artificial digestive solution.

	With digestive fluid alone.	With addition of 10 c. c. of tea.	With addition of 10 c. c. of coffee.	With addition of 10 c. c. of water.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
First experiment	94.67	68.66	61.34	93.34
Second experiment	94.00	64.67	61.24	91.32

It will be seen that the addition of pure water affected the digestion very little, while the addition of tea or coffee diminished it very materially.

At the conclusion of the digestion the liquid was filtered. The filtrate gave a peptone precipitate with nitric acid, acetic acid, and sodium chloride, but this was very small where tea or coffee had been added. The residue on the filter was a deeply colored, glutinous mass.

In former trials, in which the egg was not chopped as fine, the digestion in the presence of coffee and tea was even more unfavorable.—E. W. A.

On the preservation of milk for the determination of its fat content M. WEIBULL (*Svensk kemisk Tidsskrift, 1893*).—The author recommends potassium permanganate as a preservative and states that 60 to 100 mg. of the finely powdered salt added to about 20 c. c. of milk will keep the same for several months, "at least at the temperatures at which I have so far worked, viz, 64–72° F." Sufficient permanganate is used to give a dark brown color to the milk, and after securely corking the bottle it is immediately and vigorously shaken until all the permanganate has been dissolved. The color remains for a couple of days when the milk turns lighter colored, and after four to six days is nearly decolorized. A new portion of permanganate is then added and the brown color restored, which will insure the preservation of the milk for a long time.

Comparative analyses are given of four samples of skim milk and four of whole milk, the samples having been analyzed as they were sent in to the Alnarp experiment station, and also six to fifty-six days later, permanganate having been added. The greatest difference found was 0.1 per cent, and in eight out of eleven cases the difference was 0.05 per cent or less.—F. W. W.

Report of the control and experiment station in Christiania, Norway, 1892, F. H. WERENSKIOLD (*Norsk Landbrugs beretning for 1892, Christiania, 1893, pp. 72–92*).—This station was established October 1, 1891, and began chemical work February 1, 1892. In all 1,037 samples of feed stuffs, fertilizers, soils, dairy products, etc., were sent in for analysis or examination during 1892. Besides the analytical work done for private parties, the station conducted a number of experiments, chief among which was a coöperative fertilizer experiment to compare finely ground Thomas slag with superphosphate on clay soils. Two pounds of phosphoric acid in the form of finely ground Thomas slag was used in the place of one pound of soluble phosphoric acid in superphosphate. The experiments were originally planned by the State Agricultural Society, and have been continued for four years. The results of the first three years' trials, the only ones so far completed, show that Thomas slag in the quantities given can be advantageously substituted for superphosphate on clay soils.

Adulterations of concentrated cattle foods.—The quality of the rape-seed meal examined (84 samples) varied greatly; most samples contained a large quantity of seeds other than rape seed, and many contained only weed seeds with no trace of rape seed. "The latter kind is imported to Hamburg from southern Russia in the form of cakes, but as these can not be sold as such, having a different appearance from rape-seed cake, they are ground fine and sold either mixed with rape-seed meal or in unmixed condition. The cost of the latter goods is lower than that of rape-seed meal."

The linseed meal examined (16 samples) was often derived from impure seed or adulterated with hemp-seed meal or undecorticated cotton-seed meal. "These adulterated goods are imported from Germany (perhaps also from America), and are so finely ground that the adulteration can only be detected by microscopic examination. The protein and fat contents of such goods, as a rule, correspond with that of good linseed meal."

Rye feed (12 samples), the refuse from rye flour milling, was in one case adulterated with barley bran, and in two cases with oat bran. "Rye feed as a rule contains weed seeds, among which may be mentioned cockle and ergot. The weed seeds are generally crushed, but in several samples whole well developed seeds were found which doubtless would keep their germinative power until they could develop in the field in the spring."

Barley bran (9 samples) was also found to contain many weed seeds as a rule and also spores of ergot.—F. W. W.

TITLES OF ARTICLES IN RECENT FOREIGN PUBLICATIONS.

CHEMISTRY.

Recent advances in agricultural chemistry.—*Chem. News, 68 (1893), No. 1772, pp. 228, 229; No. 1773, p. 240.*

The examination of copper sulphate, J. RUFFLE.—*Analyst, 18 (1893), Nov., pp. 279–281.*

Distinction between iron pyrites and oxide of iron in the commercial analysis of mineral phosphates, H. H. B. SHEPARD.—*Analyst, 18 (1893), Nov., pp. 261–269.*

The action of zinc and magnesium upon metallic solutions, and the determination of potash, A. VILLIERS and F. BORG.—*Bul. Soc. Chim. Paris, ser. 3, 9 and 10, p. 602; abs. in Chem. News, 68 (1893), No. 1775, pp. 263, 264.*

A new method for determination of the pentosans occurring in plants (*Eine neue Methode zur quantitativen Bestimmung der in den vegetabilien vorkommenden Pentosanen*) E. HOTTER.—*Chem. Ztg., 17 (1893), No. 95, pp. 1743–1745.*

Methods of analysis for sugar beets (*Commission chargée d'étudier et de déterminer les conditions de l'analyse de la betterave à sucre*) L. JADOUL and A. PETERMANN.—*Bul. Min. Agr. Belgique, 9 (1893), No. 4, pp. 93–111.*

Determination of the action of diastase on starch, D. B. DOTT.—*Pharm. Jour. Trans., 53, pp. 213, 214.*

The determination of cane sugar according to Meissl in mixtures of maltose, isomaltose, dextrin, and cane sugar, and in wirt in the presence of the other carbohydrates (*Die Bestimmung des Rohrzuckers nach Meissl in Gemischen von Maltose, Isomaltose, Dextrin und Rohrzucker, sowie in Würzen, neben den anderen vorhandenen Kohlenhydraten*) J. JAIS.—*Ztschr. ges. Brauw., 16 (1893), p. 349; abs. in Chem. Ztg., 17 (1893), Repert., p. 259; and in Chem. Centbl., 1893, II, No. 19, p. 893.*

Method for the recognition of ergot (*Zum Nachweis des Mutterkorns*), C. HARTWICH.—*Schweiz. Wochenschr. Pharm., 31, pp. 369–371; abs. in Chem. Centbl., 1893, II, No. 19, p. 893.*

Method for recognition of diastase in the leaves of plants, S. JENTYS.—*Bul. Acad. Sci. Cracovic, 1892, p. 375; abs. in Centbl. agr. Chem., 22, p. 710; and in Chem. Centbl., 1893, II, No. 19, p. 890.*

The chemistry of plant fibers—celluloses, oxycelluloses, and ligno-celluloses, C. F. CROSS, E. J. BEVAN, and C. BEADLE.—*Chem. News, 68 (1893), No. 1772, pp. 225–227; No. 1773, pp. 235, 236.*

Analyses of substances of interest to agriculture—marls, fodder beets, wheat screenings, spent tan bark, and buckwheat hulls (*Analyse de substances intéressant l'agriculture*), A. PETERMANN and J. GRAFTIAU.—*Bul. Sta. Agron. Gembloux, No. 52, July, 1893, pp. 27–31.*

A new sulphureted hydrogen apparatus (*Noch ein neuer Schwefelwasserstoff-apparat*), O. HERGL.—*Chem. Ztg., 17 (1893), No. 87, p. 1599, fig. 1.*

A burette with arrangement for automatically filling to the zero mark (*Bürette mit automatischen Nullpunkteinstellung und mit Vorrichtung zur automatischen Füllung*).—*Chem. Ztg., 17 (1893), No. 85, p. 1566, fig. 1.*

An automatic apparatus for filtering and for washing precipitates with cold or hot water (*Eine selbstthätige Vorrichtung zum Filtriren und zum Auswaschen von Niederschlägen mit kaltem und heissem Wasser*), P. N. RAIKOW.—*Chem. Ztg., 17 (1893), No. 85, pp. 1565, 1566, figs. 2.*

The chemical constitution of silk (*Ueber die constitution der Seide*), H. SILBERMANN.—*Chem. Ztg., 17 (1893), No. 92, pp. 1693–1695.*

Note concerning a system of ventilating a chemical laboratory (*Note sur le système d'aerage adopté au laboratoire d'analyses de l'état a Gand.*)—*Bul. Min. Agr. Belgique, 9 (1893), No. 4, pp. 55, 56.*

BOTANY.

The andrœcium of Philadelphus (*Ueber das Andrœceum von Philadelphus*), R. WETTSTEIN.—*Ber. deut. bot. Ges., 11 (1893), No. 8, pp. 480–484.*

Observations on Sherardia arvensis (*Bemerkungen zu Sherardia arvensis*), L. GEISENHEYNER.—*Ber deut. bot. Ges., 11 (1893), No. 8, pp. 493–499.*

The morphology and development of Penicillium luteum (*Zur Morphologie und Entwicklungsgeschichte des Penicillium luteum, eines überaus häufigen grünen Schimmelpilzes*), C. WEHMER.—*Ber. deut. bot. Ges., 11 (1893), No. 8, pp. 499–516.*

Concerning the use of concentrated must for fungus cultures (*Mittheilung über die Verwendung von concentrirtem Most für Pilzculturen*), J. WORTMANN.—*Bot. Ztg., 51 (1893), No. 12, p. 177; abs. in Bot. Centbl., 56 (1893), No. 10, pp. 289–290.*

On the Nowacki law of the formation of the stalk of grain, and on the significance of the number of internodes of the stalks of rye and wheat (*Ueber das Nowackische Gesetz vom Bau der Getreidehalme und über die Bedeutung der Gliederzahl der Halme vom Roggen und Weizen*), LIEBSCHER.—*Jour. Landw., 41, No. 3, pp. 261–282.*

Boracic acid in the vegetable kingdom, with especial reference to the hop plant (*Die Borsäure im Pflanzenreiche, spec. in der Hopfenpflanze*), O. HEBERMANN.—*Allg. Brauer- und Hopfenztg. 33 (1893), p. 1781; abs. in Chem. Ztg., 17 (1893), Repert., p. 285.*

The effect on plants of the carbonic acid in the soil atmosphere, S. JENTYS.—*Bul. Acad. Sci. Cracovie, 1892, pp. 306–310; abs. in Centbl. agr. Chem., 22, p. 706; and in Chem. Centbl., 1893, II, No. 19, p. 878.*

Experiments in the substitution of strontium for lime in plant nutrition (*Versuche über den Ersatz des Kalkes durch Strontian bei der Pflanzenernährung*), E. HASELHOFF.—*Landw. Jahrb., 22, No. 6, pp. 851–861.*

Experiments on the injurious effect on vegetation of water containing nickel (*Versuche über die schädliche Wirkung vom nickelhaltigem Wasser auf Pflanzen*), E. HASELHOFF.—*Landw. Jahrb., 22, No. 6, pp. 862–868.*

The rapidity of plant growth (*Beitrag zur Kenntniss der Wachsthumsgeschwindigkeit*), F. BENECKE.—*Ber. deut. bot. Ges., 11 (1893), No. 8, pp. 473–476.*

The cause of cell-membrane thickening in the epidermis of roots (*Ueber die Ursache der Zellhautwellung in der Exodermis der Wurzeln*), A. RIMBACH.—*Ber deut. bot. Ges., 11 (1893), No. 8, pp. 467–472.*

Concerning variation in flowers (*Ueber einige Variationen an Bluthen*), F. HILDEBRAND.—*Ber. deut. bot. Ges., 11 (1893), No. 8, pp. 476–480.*

Vegetation in an atmosphere devoid of oxygen, and considerations on the dawn of animal life, T. L. PHIPSON.—*Chem. News, 68 (1893), No. 1775, pp. 259–260.*

FERTILIZERS.

The development of the theory of manuring (*Die Entwickelung der Theorie der Düngung*), A. CSERHÁTI.—*Wien. landw. Ztg., 43 (1893), No. 87, pp. 714, 715.*

Concerning the presence of fluorine in superphosphates (*Der Fluorgehalt des Superphosphates*), M. ULLMAN.—*Wien. landw. Ztg., 43 (1893), No. 90, pp. 738, 739.*

Nitrogen content of the rain water of Java (*Stickstoffgehalt des Regenwassers in Java*), MARR.—*Zuckerind., 18 (1893), p. 1521; abs. in Chem. Ztg., 17 (1893), Repert., p. 276.*

FIELD CROPS—HORTICULTURE—FORESTRY.

Experiments with varieties of potatoes (*Kartoffel-Anbauversuch des neuen landwirthschaftlichen Vereins Preuzlau*), MUHR.—*Landbote, 14 (1893), No. 88, pp. 851, 852.*

Grapes of variegated colors (*Raisins panachés*), J. DUFOUR.—*Chron. Agr. Cant. Vaud, 6 (1893), No. 10, pp. 444–448.*

Forest fires and fungus diseases of the pine (*Les agents destructeurs du pin maritime*), R. BRUNET.—*Jour. Agr. Prat., 57 (1893), No. 43, pp. 600–604.*

FOODS—ANIMAL PRODUCTION.

The elementary composition of ox meat (*Ueber die elementare Zusammensetzung des Ochsenfleisches*).—*Pflüger's Arch. Physiol., 55, No. 7 and 8, pp. 345–365.*

Analyses of Swiss hay (*Analyses de foins recoltés dans le canton de Vaud*).—*Supplement Chron. Agr. Cant. Vaud, 6 (1893), No. 10, pp. 397–433.*

The detection of horse meat (*Der chemische Nachweis von Pferdefleisch*), W. BRÄUTIGAM and EDELMANN.—*Pharm. Cent. Halle, 14 (1893), p. 557; abs. in Chem. Ztg., 17 (1893), Repert., p. 260.*

Cassava and the manufacture of tapioca on the Island of Réunion (*Le manioc et la fabrication du tapioca a la Réunion*), G. CLARENC.—*Jour. Agr. Prat., 57 (1893), No. 43, pp. 592–596.*

Potatoes as a food for horses (*Kartoffelfütterung an Pferde*), WODARG.—*Deut. landw. Presse, 20 (1893), No. 85, p. 885.*

The feeding of brans, brewers' grains, oil cakes, ground meat, etc., in place of oats for horses (*Ueber den Ersatz des Hafers bei Pferdefütterung*), TANCRÉ.—*Landw. Wochenbl. Schles. Holst., 1893, No. 42, pp. 417–419; No. 43, pp. 430–432.*

On the question of feeding raw potatoes to milch cows, steers, oxen, sheep, and horses (*Zur Frage von der Verfütterung roher Kartoffeln*), W. VON FUNKE.—*Jour. Landw., 41, No. 3, pp. 199–260.*

Rations for cattle for farmers in coöperative creameries or cheese factories (*Ueber Futterrationen für Rindviehbestande, deren Besitzer Molkereigenossenschaften angeschlossen sind*), M. MAERCKER.—*Molk. Ztg., 7 (1893), No. 44, p. 602; No. 45, pp. 614, 615.*

The advantage of cooking and steaming foods for animals (*Kochen und Dämpfen des Futters*), B. ROST.—*Molk. Ztg., 7 (1893), No. 42, p. 578.*

Personal observations on the breeding of animals in England and Germany (*Betrachtungen über englische und deutsche Viehzucht auf Grund von Reisebeobachtungen*), BACKHAUS.—*Landw. Jahrb., 22, No. 6, pp. 869–1002.*

A cross of the Shropshire and East Friesian sheep, with special reference to the production of milk (*Kreuzung von Shropshire- und Ostfriesenschafen, unter besonderer Berücksichtigkeit der Milchnutzung*), E. DRÖGE.—*Deut. landw. Presse, 20, (1893), No. 85, p. 894.*

Coöperative slaughterhouses in France (*Genossenschafts-Schlächtereien in Frankreich*).—*Milch Ztg., 22 (1893), No. 45, pp. 741, 742.*

VETERINARY SCIENCE.

Natural and artificial immunity (*Naturliche und kunstliche Immunität*), JOHNE.—*Deut. landw. Presse, 22 (1893), No. 86, pp. 891, 892.*

DAIRYING.

Effect of phosphate of lime given with the food on the ash content of the milk (*Ueber die Einwirkung des dem Futter beigegebenen phosphorsauren Kalkes auf den Aschengehalt der Milch*), J. NEUMANN.—*Milch Ztg., 22 (1893), No. 43, pp. 701–704.*

The distinction between abnormal and adulterated milk, H. D. RICHMOND.—*Analyst, 18 (1893), Nov., pp. 270–279.*

Can the specific gravity of milk which has clabbered be accurately determined? (*Beiträg zur Analyse der Milch: I. Kann man das specifisches Gewicht einer Milch die geronnen ist genau bestimmen?*), M. WEIBULL.—*Chem. Ztg., 17 (1893), No. 91, p. 1670.*

A pasteurizing and sterilizing apparatus for large creameries (*Continnirlich wirkende Milch-Pasteurisir- und Sterilisir-Anlage*).—*Wien. landw. Ztg., 43 (.893), No. 90, p. 739.*

On pasteurizing milk, and a new pasteurizing apparatus (*Ueber das Pasteurisiren und einen neuen Pasteurisir-Apparat*), DU ROI-PRENZLAU.—*Molk. Ztg., 7 (1893), No. 43, p. 590.*

The acidimeter in the dairy (*L'Acidimètre dans l'industrie laitière*), P. DORNIC.—*Ind. Lait., 18 (1893), No. 37, pp. 291, 292.*

General report on the continuous butter exhibit and test of quality at Copenhagen, 1889–'92 (*Gesamtbericht über die fortlaufenden Butter-Ausstellungen und Prüfungen in Kopenhagen 1889–1892*), P. V. F. PETERSEN.—*Milch Ztg., 22 (1893), No. 43, pp. 704–706; No. 44, pp. 721–723.*

AGRICULTURAL ENGINEERING.

The construction of silos (*Pratique de l'ensilage*), S. GUÉRAUD.—*Jour. Agr. Prat., 57 (1893), No. 33, pp. 229–232.*

The change and effect of irrigation waters, fifth paper (*Ueber die Veränderungen und Wirkung des Rieselwassers bei der Berieselung; V. Mittheilung*), E. FRICKE, E. HASELHOFF, and J. KÖNIG.—*Landw. Jahrb., 22, No. 6, pp. 801–850.*

Trial with mowing machines at Aarhus (Denmark), 1892, F. BOKELMANN.—*Tidsskr. Landökon., 12 (1893), pp. 257–334.*

The cost of mowing with various machines (*Kosten und Leistungen einer Mähmaschine*), SCHNEIDER.—*Ztschr. landw. Cent. Ver. Sachsen, Oct., 1893, pp. 369–374.*

Trial with petroleum engines at Borreby (Denmark), 1893, C. CASTENSKIOLD.—*Tidsskr. Landökon., 12 (1893), pp. 335–372.*

STATISTICS.

The viticultural school at Wædensweil, Switzerland (*École de viticulture de Wædensweil*), S. BIELER.—*Chron. Agr. Cant. Vaud, 6 (1893), No. 10, pp. 448–451.*

Annual Report of the Commissioner of Agriculture of Norway for the year 1892, *Christiania, 1893, pp. 316.*

Monthly review of the Berlin meat market, 1887–'92 (*Rückblick auf die Gestaltung der Schlachtviehpreise am Berliner Markte während der Jahre 1887–'92 in Monats- und Jahresmitteln graphisch und tabellarisch dargestellt*), G. MÜLLER.—*Milch Ztg., 22 (1893), No. 45, pp. 735–737, colored diagram 1.*

EXPERIMENT STATION NOTES.

Colorado College.—A short course in agriculture will be given this winter, beginning January 8 and continuing four weeks. Sixty lectures will be delivered upon stock feeding, dairying, irrigation hydraulics, horticulture, entomology, agricultural chemistry, farm machinery and tools, and the science of government; and the afternoons will be devoted to milk testing, irrigation, horticulture, and work in the mechanical department.

Georgia Station.—At the regular meeting of the board of directors of the station, November 10, 1893, all the station officers were re-elected, excepting R. E. Hardee, assistant chemist, who resigned. For the present the station will dispense with a resident chemist.

Illinois Station and College.—The experiment farm of the University of Illinois, with its buildings and a part of the equipment of live stock and machinery, has been placed under the control of the station.

The College of Agriculture of the University of Illinois announces a free short course in agriculture to be given during the first three months of 1894. Four class exercises will be given daily, consisting mainly of lectures by the professors in the university, members of the station staff, and other scientists. These lectures will be illustrated by free use of the university apparatus, collections, and models; and the libraries, laboratories, museums, greenhouses, and barns will be open for investigation and use by the students of the course.

Indiana School of Agriculture.—Purdue University offers an eight weeks' course in live-stock husbandry and dairying, two free scholarships being given to each county agricultural society. The instruction will consist of about fifty lectures by professors connected with the university, and special lectures on horses, cattle, sheep, swine, and poultry, by prominent breeders and specialists.

Nebraska Station.—Prof. White, from Cornell University, Ithaca, N. Y., takes the place made vacant by Prof. G. B. Frankforter who has gone to Minnesota.

Ohio Station.—A substation is being organized at Neapolis in the northwestern part of the State for the purpose, chiefly, of studying the problem of maintenance of soil fertility on sandy land. The location selected is near the corners of Fulton, Henry, and Lucas Counties, in what is known as the "oak openings," a region celebrated for its sterility. Forty acres of new land have been leased for ten years. It is being cleared and drained, and will be cropped the coming spring. Mr. James S. Hine, B. Sc., is the superintendent in charge.

North Carolina Station.—The plan is instituted by the station of having a popular summary of the contents of every bulletin occupy the first eight pages of the bulletin. This will be complete in itself and give to the popular reader about all he would desire to learn from the experiments described. Only these eight pages will be sent to the general list in the State. On the eighth page will be given a table of contents of the following pages which describe the experiment in detail, with a statement that those who may upon application receive the complete bulletin. The complete bulletin will be sent as usual to all scientific exchanges, newspapers, experiment station officers, boards of control, etc.

The advantages of this plan are that it supplies to farmers only what they particularly and most generally wish to know, and prevents wasteful distribution.

WASHINGTON STATION.—Another piece of land has been acquired for a branch station in the Snake River country, which will be devoted almost entirely to horticulture. The tomato disease which has made such ravages in this crop during the last three years is to receive early attention.

INDEX TO AGRICULTURE OF MASSACHUSETTS.—A synoptical and analytical index to the fifty-two volumes (1837–'52) of Agriculture of Massachusetts has been prepared by F. H. Fowler, under direction of the State Board of Agriculture.

THE NINTH ANNUAL REPORT OF THE NEW YORK DAIRY COMMISSIONER for 1892 contains an extended account of prosecutions under the laws prohibiting adulteration of dairy products; records of various experiments in feeding and care of cows, and in making and handling butter and cheese; and a review of the condition of dairy interests throughout the State.

ANNUAL MEETING OF THE ASSOCIATION OF SWISS ANALYTICAL CHEMISTS, 1893.—*Chemiker Zeitung (17, No. 83 and No. 84)* gives a report of the meeting held at St. Gall, September 28–30, 1893. The principal subjects treated are, (1) examination and judgment of medicinal sweet wines; (2) examination and judgment of honey; (3) testing of raw spirits, and (4) communication on brandy.

Honey is defined as the substance secreted and stored in wax cells by the honey bee. The tests and determinations recommended are microscopic examination, determination of specific gravity of a solution of one part by weight of honey and two parts of water, determination of ash and "flour," and polarization before and after inversion. The various sugars, water, and saccharin may also be determined.

Flour is determined in the aqueous solution with iodine. When the polarization of 50 c. c. of a 1 to 2 honey solution in a 220 mm. tube at 15° C. in a Wild polaristrobometer is at least $-6° 30'$, the honey is not regarded as suspicious unless other tests have pointed that way.

AGRICULTURAL EDUCATION IN GREAT BRITAIN.—The report of the board of agriculture on the grants for agricultural education in Great Britain for 1892–'93, gives an account of the courses of instruction and the experimental work of the institutions receiving grants of money from Parliament. Great interest is shown in the popular courses of lectures delivered in numerous localities and in the special courses in dairying.

AGRICULTURE AND FORESTRY IN RUSSIA.—A book of five hundred pages was published by the Department of Agriculture and Rural Industry of Russia for use in connection with its exhibit at Chicago. The publication describes the extent and character of the various branches of agriculture in the different sections of Russia, and affords a means of comparison of the Russian and American systems.

RECENT ARTICLES BY STATION WORKERS.—*Journal of the American Chemical Society, (vol. XV, No. 11):* The composition of American Cheddar cheese, L. L. Van Slyke; The determination of casein in cows' milk, L. L. Van Slyke; Some points relating to the composition of cows' milk, L. L. Van Slyke. *Vol. XV, No. 12:* A drying oven for drying in hydrogen at the temperature of boiling water, F. W. Morse.

ASSOCIATION OF ECONOMIC ENTOMOLOGISTS.—The following are the officers for the coming year: L. O. Howard, president, Washington, D. C.; J. B. Smith, vice-president, New Brunswick, New Jersey; F. L. Harvey, second vice-president, Orono, Maine; C. P. Gillette, secretary, Fort Collins, Colorado.

LIST OF PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE.

DECEMBER, 1893.

DIVISION OF CHEMISTRY:

Bulletin No. 38.—Proceedings of the Tenth Annual Convention of the Association of Official Agricultural Chemists.

DIVISION OF ENTOMOLOGY:

Insect Life, vol. VI, No. 2, December, 1893.

OFFICE OF EXPERIMENT STATIONS:

Experiment Station Record, vol. IV, No. 12, July, 1893.

Experiment Station Record, vol. V, No. 1.

Bulletin No. 15.—Handbook of Experiment Station Work.

LIST OF STATION PUBLICATIONS RECEIVED BY THE OFFICE OF EXPERIMENT STATIONS.

DECEMBER, 1893.

AGRICULTURAL EXPERIMENT STATION OF THE AGRICULTURAL AND MECHANICAL COLLEGE OF ALABAMA:

Bulletin No. 49, October, 1893.—Varieties of Wheat and Grasses.

Bulletin No. 50, November, 1893.—Fruit Tree Blight in General.

AGRICULTURAL EXPERIMENT STATION OF THE UNIVERSITY OF CALIFORNIA:

Annual Report, 1891-'92.

DELAWARE COLLEGE AGRICULTURAL EXPERIMENT STATION:

Fourth Annual Report, 1891.

AGRICULTURAL EXPERIMENT STATION OF FLORIDA:

Annual Report of Treasurer, 1892.

Bulletin No. 20, September, 1893.—Soils and Fertilizers.

AGRICULTURAL EXPERIMENT STATION OF INDIANA:

Bulletin No. 46, September, 1893.—Modification of Grandeau's Method for Determination of Humus; Determination of Crude Fiber.

Bulletin No. 47, November, 1893.—Does it Pay to Shelter Milch Cows in Winter? Skim Milk as a Food for Calves.

MARYLAND AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 22, September, 1893.—Steer Feeding.

HATCH EXPERIMENT STATION OF THE MASSACHUSETTS AGRICULTURAL COLLEGE:

Meteorological Bulletin No. 59, November, 1893.

AGRICULTURAL EXPERIMENT STATION OF NEBRASKA:

Bulletin No. 29, April, 1893.—Cost of Farm Crops.

Bulletin No. 30, October 1, 1893.—The Influence of Changes of Food and Temperature on the Quantity and Quality of the Milk of Dairy Cows.

NEVADA AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 20, March, 1893.—Potatoes; Tobacco.

Bulletin No. 21, September, 1893.—Nevada Weeds.

NEW JERSEY AGRICULTURAL EXPERIMENT STATIONS:

Bulletin No. 97, November, 1893.—Analyses and Valuations of Fertilizers.

PENNSYLVANIA STATE COLLEGE AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 24, July, 1893.—Influence of Quantity of Food upon Economy of Milk and Butter Production.

RHODE ISLAND AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 26, November, 1893.—Fertilizers; Oats; Potato Scab.

TENNESSEE AGRICULTURAL EXPERIMENT STATION:

Bulletin vol. VI, No. 3, July, 1893.—Small Fruits; Grapes.

Bulletin vol. VI, No. 4, October, 1893.—Field Experiments with Tomatoes and Onions.

Texas Agricultural Experiment Station:

Bulletin No. 27, June, 1893.—Steer Feeding.

Agricultural Experiment Station of the University of Wisconsin:

Bulletin No. 37, October, 1893.—The Russian Thistle.

DOMINION OF CANADA.

Ontario Agricultural College Experiment Station:

Bulletin No. 91, November, 1893.—Weeds of Ontario.

Bureau of Industries, Toronto, Ontario:

Bulletin No. 48, November, 1893.—Crops and Live Stock in Ontario.

PUBLICATIONS OF THE OFFICE OF EXPERIMENT STATIONS.

The Office of Experiment Stations issues three classes of publications for general distribution:

(1) Experiment Station Record, and (2) Bulletins, which are more or less technical. It is the practice to send to persons applying for them one or more numbers, from which they may judge of their usefulness, but not to place any names upon the mailing list until after receipt of applications on special blanks furnished by the Office.

(3) Farmers' Bulletins, which are brief and popular in character, and are sent on application. These bulletins are issued as part of the general series of Farmers' Bulletins of the Department of Agriculture.

The following publications have been issued:

Experiment Station Record, vol. I, 6 numbers; vol. II, 12 numbers; vol. III, 12 numbers and index; vol. IV, 12 numbers, including index; vol. V, Nos. 1–4. Copies of the Station and Department publications abstracted in the Record can, in many instances, be obtained on application.

Bulletins.—No. 1, Organization and History of the Stations; No. 2, Digest of Annual Reports of the Stations for 1888, in two parts; No. 3, Report of Meeting of Horticulturists at Columbus, Ohio, June, 1889; No. 4, List of Station Horticulturists and Outline of their Work; No. 5, Organization Lists of Stations and Colleges, March, 1890; No. 6, List of Station Botanists and Outline of their Work; No. 7, Proceedings of the Fifth Annual Convention of the Association of American Agricultural Colleges and Experiment Stations, Washington, D. C., August, 1891; No. 8, Lectures on Investigations at Rothamsted Experimental Station; No. 9, The Fermentations of Milk; No. 10, Meteorological Work for Agricultural Institutions; No. 11, A Compilation of Analyses of American Feeding Stuffs; No. 12, Organization Lists of the Agricultural Experiment Stations and Agricultural Schools and Colleges in the United States, June, 1892; No. 13, Organization Lists of the Agricultural Experiment Stations and Agricultural Schools and Colleges in the United States, April, 1893; No. 14, Proceedings of a Convention of the National League for Good Roads, January, 1893; No. 15, Handbook of Experiment Station Work; No. 16, Proceedings of the Sixth Annual Convention of the Association of American Agricultural Colleges and Experiment Stations, New Orleans, Louisiana, November, 1892; No. 17, Suggestions for the Establishment of Food Laboratories.

Miscellaneous Bulletins.—No. 1, Proceedings of Knoxville Convention of Association of Agricultural Colleges and Stations, January, 1889; No. 2, Proceedings of Washington Convention of the Association, November, 1889; No. 3, Proceedings of Champaign Convention of the Association, November, 1890. (Series discontinued.)

Farmers' Bulletins.—No. 1, The What and Why of Agricultural Experiment Stations; No. 2, Illustrations of the Work of the Stations; No. 9, Milk Fermentations and their Relation to Dairying; No. 11, The Rape Plant.

Communications intended for this Office should be addressed to the SECRETARY OF AGRICULTURE, for the *Office of Experiment Stations, Department of Agriculture, Washington, D. C.*

The Agricultural Experiment Stations in the United States.

R. Kent Beattie

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U. S. DEPARTMENT OF AGRICULTURE

OFFICE OF EXPERIMENT STATIONS

Vol. V No. 6

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U. S. DEPARTMENT OF AGRICULTURE

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STATISTICS.

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EXPERIMENT STATION RECORD.

VOL. V. NO. 6.

Next to the agricultural experiment stations, one of the most active agents at present in promoting agriculture in Germany is the German Agricultural Society. This society, according to its constitution, is an association of farmers and persons interested in agriculture, devoted to the promotion of agriculture in the German Empire. It is national in its character and is one of the largest associations of its kind in the world. It numbers among its members the foremost agriculturists and farmers of the country, including many of the investigators connected with the agricultural experiment stations and institutions of learning. It has a membership at present of 9,371 persons, which it has acquired in less than ten years of existence.

The idea of this national agricultural society was conceived by Max Cyth, an agricultural engineer who had spent many years in England and seen the workings of the Royal Agricultural Society of that country. Through his efforts a provisional society was organized at Hamburg in 1884 with 336 members and with Count Otto von Stolberg, of Wernigerode, as honorary president. The formal organization as the German Agricultural Society took place in September, 1886, with 2,500 members. Since that time the membership has increased very rapidly, the additions for the past three years averaging 1,250 members per annum.

The society accomplishes its purposes through an annual meeting and fair held in September in different places from year to year; a general winter meeting held at the headquarters of the society in Berlin; meetings of the sections on fertilizers, plant culture, seeds, implements, and agricultural technology and engineering; prize essays based on scientific investigations of various agricultural questions; testing materials of interest to agriculture; coöperative experiments and experiments carried out at its request by agricultural experiment stations, and through its regular publications, which include an annual report, or year book (*Jahrbuch der deutschen landwirtschafts Gesellschaft*), containing over 600 pages of information in 1893, and a journal (*Mittheilungen der deutschen landwirtschafts Gesellschaft*) appearing irregularly two or three times a month.

The annual meeting and agricultural fair was held in 1893 in Munich, and was the eighth held by the society. At this there were entered 3,674 head of farm animals of various kinds, 1,552 exhibits of agricultural products, and 1,982 exhibits of farm implements and machinery; and cash prizes amounting to $19,600 were awarded. There were 106,600 paid admissions, amounting to about $31,825. In nearly every respect the Munich fair was the largest and most successful one held by the society.

The various sections of the society meet at Berlin several times during the year. Here, in addition to general business, papers are read, many of which are of very general interest to agriculture. For instance, the past year Prof. Maercker read a paper at a session of the fertilizer section on the form of phosphoric acid to be recommended from the present status of knowledge, and the present condition of the phosphate market; and at another meeting of the same section Prof. Fleischer discussed soil inoculation, the results secured, and the prospects. Before the seed section, Prof. Leibscher read a paper on progress in plant breeding. These are only examples from a list of many papers, all practical in their application. The full text of these papers is published in the year book.

The experimental work of the society is extensive and varied, including studies on the culture, manuring, diseases, and protection of plants, the rearing of animals, etc. The subject of dairying does not appear to have received attention, being left presumably to the German Dairy Association. At present the following experiments are under way: Experiments on the physiological action of potash salts on cultivated plants, which have been carried on for three years at the experiment station in Bernburg and will be continued another season; tests of the manurial action of carnalit as compared with kainit, which were commenced the past year at the experiment stations at Halle and Bremen and are to last three years; experiments in manuring tobacco, now in the second year; experiments in the preservation of barnyard manure, commenced the past year at the stations at Darmstadt, Jena, Rostock, and Augsburg, and to be extended the coming year to some twelve estates; field experiments to compare nitrate of soda with ammonium sulphate, continued for several years; culture experiments with plants used for green manuring; experiments in preventing fungus diseases and other ravages; variety tests of grains; and slaughter experiments. Experiments in manuring vineyards and potatoes are to be undertaken the coming season. Thus the society is in hearty coöperation with the agricultural experiment stations, supplementing their work in many directions. It does not attempt to carry on the more profound investigations but looks to the stations to do that. For its part it popularizes the results of abstract scientific investigation and endeavors to induce farmers to apply them in their practice. This application of the results of science to practice forms one of the strongest features of the society's work.

Another line in which the society has done useful work is in instituting coöperation among its members in the purchase of fertilizing materials, seeds, and feeding stuffs. Many farmers are said to join the society for this feature alone. Announcement is made in the journal of the society when the orders for goods are to be made up, and members send in their orders before that date. The quantities purchased are so large as to enable the society to secure reliable goods at very considerable reductions. This feature has grown very rapidly since it was undertaken in 1885. The past year the society purchased for its members 2,791 tons of fertilizing materials; over 26 tons of seeds, valued at $215,000; and over 112 tons of feeding stuffs, valued at $300,300. The fertilizers were mostly agricultural chemicals bought by members for home-mixing.

The society occupies an entire building in Berlin as its headquarters. Here it has a permanent secretary and other officers, including an agricultural chemist. As mentioned elsewhere (p. 63), it has just opened a chemical laboratory where the chemical work connected with its coöperative field experiments, the analysis of materials of interest to agriculture, etc., can be carried on. No control work will be done here, however. It has a bureau of information which endeavors to supply information on all sorts of agricultural subjects, in response to questions sent in by members.

The German Agricultural Society is nonpolitical. It takes no part whatever in the discussion of political questions and its constitution debars such matters from its consideration. It is devoted exclusively to the promotion of agriculture and to the welfare of the German farmers.

AGRICULTURAL EXPERIMENT STATIONS IN BELGIUM.

Dr. A. Petermann.

The experiment station movement began in Belgium, as it had years before in Germany, with the action of an association of men intent upon utilizing science for the benefit of farming. The first German station was established at Möckern in 1852. The first station in Belgium was established in 1872. Both were afterwards taken charge of by the Government and are now well supported from the public treasury. But while in Germany the stations which have since become numerous and influential are more or less autonomous, in Belgium they are all Government institutions and constitute a definitely organized system. This system consists of the station at Gembloux, which is devoted to experimental research, and seven auxiliary institutions in as many different places. The latter were established first as agricultural laboratories for the purpose of testing fertilizers, feeding stuffs, seeds, soils, and waters, and have since had their functions extended to include the examination of food products, beverages, drugs, etc.

The influences which led to the establishment of stations in Belgium were like those which have obtained elsewhere. The labors of such men as Liebig in Germany, Boussingault in France, and Lawes and Gilbert in England furnished the earlier incentive; the success of the regularly organized experiment stations in Germany gave the later and most powerful impulse. Two causes were especially operative in the introduction and rapid spread of the stations in Belgium. The first was the necessity, which was becoming from day to day more urgent, of buying commercial fertilizers, seeds, and concentrated foods of guaranteed standards. The second was the more and more clearly recognized usefulness of scientific investigation conducted in behalf of agriculture by specialists supplied with facilities requisite for the work.

Belgium could not long remain behind her neighbors in this movement. Thanks to the initiative taken by the professors of the Government Agricultural Institute at Gembloux and by the Agricultural Society of Brabant-Hainaut, and thanks to the coöperation of many of the devoted friends of agriculture under the leadership of Messrs. T'Serstevens, De Bruyn, De Wilde, De Marbair, Lippens, Leclercq, Lejeune, and Parisel, sr., an association of farmers, manufacturers, and other persons interested in agriculture was formed September 25, 1871, under the name of "The Association for Founding of Agricultural Experiment Stations in Belgium." The Government justly appreciating

the services which such an association would be called upon to render to agriculture, granted at the outset an annual subsidy of $2,000, which some years later was increased to $2,800, and a special subsidy of $4,000 for the establishment of the first experiment station at Gembloux. The aim of this association was to serve the Belgian farmers, in part by use of the already acquired results of chemical and other scientific investigations, and in part by a scientific study of the needs and problems of practical agriculture as well as the results of its experience. In establishing stations and laboratories the association strove to attain these objects by (1) researches and experiments in the production of plants and animals, in sylviculture, etc.; (2) lectures and other educational propaganda; (3) periodical publications; (4) special investigations, consultations, and reports, including analyses and other tests, control of commercial fertilizers, feeding stuffs, seeds, etc.; (5) advice given to its members.

In February, 1872, the association honored the writer by calling him to Belgium to organize these institutions and to take charge of the first station—that at Gembloux. This was opened to the public on the 5th of July following, and although the first year recorded only a modest beginning, 94 analyses, this number, when confidence in the work had once become established, increased to such considerable proportions that on May 4, 1873, the general assembly expressed its desire to establish a second station at Ghent. This wish was realized in 1875. The new station, or agricultural laboratory as it was called, was placed in charge of M. Simon, who was succeeded some months later by M. Crispo; both of these men had been previously connected with the station at Gembloux. The number of manufacturers of fertilizers who desired to place their goods under the control of the station continually increased, the specimens for analysis of products of all kinds flowed in from all sides, the services rendered to the agricultural public by the two stations were more and more appreciated, and in 1878 it became necessary to establish two more agricultural laboratories—one at Liège and the other at Hasselt. Other provinces made urgent requests for similar institutions, but in spite of the encouragement, both moral and pecuniary, offered by the Royal Government and by the provinces, the resources of the association were inadequate to meet the new expenses, and the general assembly of 1882 decided to ask the Government to take charge of the work thus begun and care for its further development. The association published a memorial* on this occasion, reviewing the steps already taken, the status of the stations and laboratories, and the services they had rendered. The Government, recognizing the value of the agricultural stations and laboratories to the community, assumed the financial responsibility for them by the royal act of June 30, 1883.

* L'Oeuvre de l'Association pour la Fondation de Stations Agricoles Experimentales en Belgique, par A. Petermann, Directeur Général des Stations Agricoles, Bruxelles, 1882.

That the association had not overestimated the interest of the Government in the institutions which had been thus committed to its care, was evinced by the fact that scarcely a year passed before M. de Moran, then minister of agriculture, gave directions for the establishment of three new laboratories, at Antwerp, Louvain, and Mons.

The number of analyses largely increased, and at Gembloux, the oldest of the stations, this work began to interfere with that of experimental inquiry. A royal act of August 3, 1887, provided for a division of labor by dividing the station into two institutions distinct in purpose and personnel and occupying separate apartments in the buildings of the agricultural school. One of these, the agricultural experiment station (*Station Agronomique*), was devoted to experimental research, while the other, the agricultural laboratory, was made coördinate with the laboratories at Ghent, Liège, and elsewhere, and devoted to public analyses.

For many years the adulteration of food products had been a serious evil to the Belgian public, and the Government had been obliged to take special legislative steps to check this abuse. The agricultural laboratories being now under its control, the Government in 1891 gave over to their charge, in connection with several private chemists, the analysis of specimens of foods taken in accordance with the rules governing trade inspection. This new measure involved a reorganization, and the "state agricultural laboratories" became the "state analytical laboratories," the more general name corresponding better to their new functions.

By this process of evolution, which has been shaped largely by accidental conditions, the original work of the association for the establishment of agricultural experiment stations in Belgium has resulted in the development of a well-conceived, well-organized, and important system of institutions for the public welfare.

PRESENT ORGANIZATION OF THE STATE EXPERIMENT STATIONS AND ANALYTICAL LABORATORIES.

The Experiment Station at Gembloux.—This station is organized in conformity with the royal decree of June 12, 1892, and the regulations of the Minister of Agriculture, Industry, and Public Works, of June 13 of the same year. In accordance therewith, its objects are (1) to engage in investigations in chemistry and vegetable and animal physiology, which seem to be in the interest of the advancement of agriculture; (2) as occasion may demand, to assist the various branches (industry, agriculture, rains and frosts, health and hygiene, etc.) of the ministry under which it stands in the scientific investigations needed in dealing with questions included in their jurisdiction. The station is administered by the Bureau of Agriculture, from whose budget its accounts are paid. It is under the immediate supervision of the Inspector-general of Agriculture.

The working staff consists of the director and the chief assistant (*chef de travaux*), who are appointed by the King, and two assistant chemists, a clerk, a laboratory janitor, and a servant, chosen by the director.

The salary of the director begins with $1,100 per annum, is increased at the end of four years to $1,200, and at the end of four years more to $1,300, and may, at the end of at least six years more, be further increased by one tenth. In addition to this salary a dwelling is provided for the director. The salary of the chief assistant ranges in like manner from $600 to $700, with opportunity of further increase of a tenth. The assistant chemists receive from $300 to $500, the clerk from $240 to $360, and the janitor from $180 to $240. An annual vacation of fifteen days is allowed to the director, chief assistant, and assistant chemists. The hours of labor for employees are from 8 a. m. until noon, and from 2 to 5 p. m., except Sundays and holidays. The station occupies some fifteen rooms in the buildings of the agricultural school, which was formerly a convent. Four of these rooms are used as analytical laboratories, two are reserved for experiments in animal physiology, others serve for offices, museums, storerooms, and other purposes. A piece of land adjoining the station is set apart for field experiments. On this is a greenhouse built especially for experiments in vegetable physiology.

During the month of December of each year a programme for the work of the coming year is submitted by the director to the minister of agriculture for approval. The annual estimate of expenses is presented to the minister by the director in January. The director submits reports of operations to the same officer. The accounts of the station and its work are published in the *Bulletins de la Station Agronomique* and the annual report in the *Bulletin de l'Agriculture.*

Analytical laboratories.—There are seven laboratories, organized by the same authority and under the same royal and ministerial regulations as the experiment station at Gembloux. Their object is to provide analyses of soils, fertilizing materials, and agricultural products, tests of seeds; analyses of foods, including all substances used for the nutrition of man and animals, and also analyses of any material used in the manufacture and preparation of foods. They are under the supervision of a commission of seven members appointed by the King and including the director of agriculture, the inspector-general of agriculture, the inspector of health and hygiene, the inspector of foods, and the director of the experiment station at Gembloux. This commission not only exercises such charge of the laboratories as to (1) make sure that they fulfill their purpose as defined by the Government and (2) secure the adoption of uniform methods of analysis, testing, etc., but also (3) takes account of questions regarding the arrangement of terms of contract with manufacturers of feeding stuffs, fertilizers, etc., who place their wares under control of the laboratories; the tariff of prices for

analyses; the personnel of the laboratories; and the relations with provincial, communal, or private laboratories. Each of these seven state laboratories is placed under the immediate oversight of a local commission of five members, two of whom are appointed by the minister and the rest by legislative, agricultural, and medical organizations.

The minister of agriculture, industries, and public works is the final authority in regard to the administrative policy of the laboratories, the regulation of tariffs of prices and the making of contracts with dealers whereby wares are sold under control of the laboratories and analyzed without expense to purchasers. The Government assumes no responsibility for the accuracy of the analyses; this responsibility rests with the director of the laboratory.

The staff of each laboratory consists of a director, one or two chief assistants, one or more assistants, and one or two laboratory servants. The directors and chief assistants are appointed by the King, the other assistants and servants by the minister. The salary of the director begins with $700, is increased at the end of four years to $800, and in four years more to $900, and after not less than six years more may be increased one tenth. In addition to his salary a dwelling is provided for the director. The salary of a chief assistant ranges in like manner from $600 to $700 in eight years, and may after six years more of service be raised one tenth.

Reports of the work of each of these institutions are published yearly in the *Bulletin de l'Agriculture.* Meetings of the directors are held two or three times a year, under the presidency of a member chosen by the minister of agriculture, to discuss the improvement of methods and to secure uniformity of action. The laboratory methods are essentially the same as those used in the experiment stations of Germany and France.

The following is a list of the state laboratories, with location, date of foundation, name of present (1893) director, and number of persons on the staff:

(1) *Gembloux.*—Established in 1872 as part of the experiment station, and made an independent laboratory in 1886. Director, M. C. Masson, formerly assistant of the experiment station; four assistsnts, a clerk, and a janitor.

(2) *Ghent.*—Established in 1875. Director, M. Nyssens; three assistants and a janitor.

(3) *Hasselt.*—Established in 1878. Director, M. Mercier, formerly assistant at the Gembloux Station; one assistant, a clerk, and a janitor.

(4) *Liége.*—Established in 1878. Director, M. de Molinari, formerly assistant at the Gembloux Station; five analytical assistants, one assistant in bacteriology, a clerk, and a janitor.

(5) *Antwerp.*—Established in 1885. Director, M. Crispo, formerly assistant at the Gembloux Station; three assistants, a clerk, and a janitor.

(6) *Louvain.*—Established in 1885. Director, M. Claes; two assistants, a clerk, and a janitor.

(7) *Mons.*—Established in 1885. Director, M. Warsage, formerly assistant at the Gembloux Station; three assistants, a clerk, and a janitor.

In addition to the above seven state laboratories the following may be mentioned: *

(8) *Provincial agricultural laboratory at Roulers.*—Director, M. Van der Berghe.
(9) *Agricultural and hygienic laboratory of the city of Courtroi.*—Director, M. D'Hout.

THE BELGIAN SYSTEM OF CONTROL OF FERTILIZERS AND FEEDING STUFFS.

The chief function of the state laboratories is the control of fertilizers and feeding stuffs by analyses. The system by which this is done is the outgrowth of the same experience which has led to the establishment of the laboratories in their present form. It is defined by the ministry of agriculture, industry, and public works. † It takes account of the Belgian law regarding the adulteration of fertilizers, which requires that every lot sold shall be accompanied by a statement of its nature and percentages of valuable ingredients. The Government provides for a specific form of contract between the seller as the party of the first part and itself, as represented by the minister of agriculture as the party of the second part. By this contract, for which blanks are furnished to be filled out in due form and signed by the minister and the dealer in the wares. The dealer binds himself to guaranty the percentages of specified ingredients and indemnify the purchaser at certain rates if the percentages, on analysis at the state laboratory, fall below the guaranties. He also pays a certain sum to the Government toward covering the expenses of the analysis. The Government in its turn provides the laboratory and gives to every citizen of Belgium who purchases $10 worth or more of a fertilizer from a dealer who has placed his goods under control, the right to have a sample analyzed free of charge. Detailed regulations are laid down as to the manner of expressing the name, character, and composition of the goods, taking the sample, forwarding to a specified laboratory, statement of analysis, settling of questions as to corrections of analyses, permissible range of variation from guarantied percentages, indemnification of purchaser when called for, etc.

SPECIAL FEATURES OF THE STATE EXPERIMENT STATION AT GEMBLOUX AND ITS WORK.

This institution, as already implied, is the central station of the Belgian system.

The director, who has filled this position since the organization of the station in 1872, is Prof. A. Petermann, Sci. Dr., previously assist-

* Vid. Hobbe, Statistics of Experiment Stations in Mentzel and v. Lengerke, Landw. Kalender, 1894, II, 377.

† In a publication dated 1892 and entitled *"Laboratoires d'Analyse de l'Etat. Convention relative au control gratuit des matieres fertilisantes et des substances alimentaires pour le betail."*

ant at the experiment stations in Pommritz, Saxony, and Nancy, France, and director of the station at Prîlep, Austria. The chief assistant is M. J. Graftiau.

The equipment of the station includes, as mentioned above, a well-furnished chemical laboratory, with museum and apartments for experiments on the nutrition of animals; an experimental garden and field; a greenhouse with special arrangements for vegetation experiments; a series of boxes near by, also especially constructed for like purpose; and a meteorological observatory.

Accounts of the work of the station are regularly published in the bulletin of the station and the *Bulletin de l'Agriculture* above named. Some of the researches are reported in the *Bulletin de l'Académie Royale des Sciences* of Belgium. The investigations from 1872 to 1886 have been collated in vol. I of a work by Dr. Petermann entitled *Récherches de chimie appliqué a la physiologie;* those from 1886 to 1892 are being printed in vol. II of the same work. Translations and abstracts have appeared in various European and American publications.

Subjects of investigation.—The range and amount of inquiry carried on by the station may be inferred from the list of the notes, articles, and memoirs thus far published. This includes the following: Researches in agricultural chemistry and physiology, 34 titles; analyses of fertilizing substances, 23 titles; analyses of feeding stuffs and foods, 10 titles; miscellaneous, 10 titles; total, 77 titles. Among the investigations of general as distinguished from local interest are those upon phosphates and guanos from different sources; the fertilizing values of sundry nitrogenous waste products; the value of so-called "reverted" phosphoric acid; the sugar beet and its culture; the composition of numerous materials used for food. Especial mention should be made of the researches upon the composition of the atmosphere and the acquisition of atmospheric nitrogen by plants, and the studies of methods of investigation of sugar beets and of soils. The methods of meteorological observation are also worthy of note.

The list of books and pamphlets upon special subjects published by the director and his associates, Messrs. Graftiau and de Marneffe, is also quite extensive.

Meteorological observations.—In addition to the usual observations of temperature, barometric pressure, precipitation, cloudiness, etc., the station has since 1892 carried on actinometric observations (intensity of illumination), and has also studied at the same time the temperature of the neighboring soil, both with and without vegetation, at the surface and at different depths.

Methods of soil investigation.—Much attention has been given to this subject by the station, which has had as special incentives the frequent calls for analysis, a special demand in connection with the preparation of agricultural maps of Belgium, and finally the need of a

uniform method for use in the several state laboratories. The director has prepared a memoir upon the subject,* which gives full details of methods as adopted and elaborated by him.

While recognizing that the "physiological analysis" of the soil, or, in other words, the analysis of the soil by the plant, is better adapted in principle to give a correct estimate of its immediate resources than chemical analysis, he nevertheless considers that various undeterminable factors, such as the influence of the weather, of cryptogams, animals, man, etc., render the physiological method inferior to physical-chemical analysis as regards scientific accuracy.

In consequence, chemical analysis and analysis of the soil by the plant ought to go hand in hand and each should control and supplement the other.

The method published by us is not wholly new or original, but rests essentially on the application of the general principles of chemistry and the lines laid down in the classic treatises of Wolff, Grandeau, and Müntz. Nevertheless, our own long experience in this field, in connection with that of our associates at the station, has enabled us, after many experiments, confirmatory tests, and special studies, to make selections from the recognized methods, to improve many of them, to make current use of the analysis of the portion of the soil insoluble in mineral acids, and to establish a method by which the portion of phosphoric acid capable of easy assimilation may be separated from the total phosphoric acid.

The method for the analytical treatment of soils may be divided as follows: (1) A general analysis, (2) a physical-chemical analysis of the fine earth, (3) a chemical analysis of the fine earth, including the analysis of the residue insoluble in hydrochloric acid, and (4) special determinations.

(1) *General analysis.*—This includes the determination of (*a*) the weight of a liter of the air-dried soil; (*b*) the percentage of water in the air-dried specimen; (*c*) its water-holding capacity when air-dried; (*d*) its reaction, whether acid or neutral; (*e*) the percentages of organic and of mineral débris, and (*f*) the proportion of fine earth by passing through a sieve with openings of 1 mm.

(2) *Physical chemical analysis of the fine soil.*—The quantities of coarse sand, fine sand, sand powder, and clay in the sifted air-dried soil are determined according to the method of Schlösing, which consists in moistening the soil, separating the clay by treatment with successive small portions of water, and precipitating the clay from the water. The different grades of sand are separated by sieves, that which does not pass through 0.5 mm. holes being taken as "coarse sand," that which is held by 0.2 mm. holes as "fine sand," and that which passes through the latter but is not floated off by water as "sand powder."

(3) *Chemical analysis of the fine soil.*—This includes determinations of: (*a*) Moisture by drying to constant weight at 150°; (*b*) material volatile and combustible at low red heat; (*c*) chlorine; (*d*) nitric acid by

*L'analyse du sol. Méthode suivie à la station agronomique de l'État à Gembloux. Dr. A. Petermann, Bruxelles, G. Mayolez, 1891: 63 pp.

method of Schlösing; (*e*) ammonia by Boussingault's method, *i. e.*, distilling with magnesia; (*f*) organic nitrogen by soda lime method; (*g*) silicic, phosphoric, and sulphuric acids, potassium, sodium, oxide of iron, aluminium calcium, and magnesium, in the portion dissolved by digestion in the cold with hydrochloric acid of 1.18 specific gravity; (*h*) carbonic acid; and (*i*) treatment of residues insoluble in hydrochloric acid with hydrofluoric acid and subsequent determination of potassium, calcium, magnesium, and phosphoric acid.

(4) *Special determinations.*—These include (*a*) detailed observations in regard to kind of organic matter present; (*b*) studies of soil extracts with the use of various solvents, as dilute solutions of carbonic, hydrochloric, or acetic acid, or alkaline solution of ammonium citrate; (*c*) dialysis of the soil; (*d*) the coefficients of absorption (according to Knop); (*e*) special physical properties; (*f*) the microörganisms of the soil (the study of these latter is, however, difficult, and requires bacteriological training); (*g*) presence of iron salts; and (*h*) investigation of occasional rare constituents, such as fluorine, arsenic, iodine, etc.

In addition to the detailed description of the plan of analysis, the memoir includes a large amount of experimental data bearing upon the various individual methods obtained in studies upon them at Gembloux, and a bibliography of the subject of soil analysis.

ABSTRACTS OF PUBLICATIONS OF THE AGRICULTURAL EXPERIMENT STATIONS IN THE UNITED STATES.

CHEMISTRY.

E. W. ALLEN, *Editor.*

A modification of Grandeau's method for the determination of humus, H. A. HUSTON and W. F. MCBRIDE (*Indiana Sta. Bul. No. 46, Sept., 1893, pp. 68–79, fig. 1*).—In using the Grandeau method for determining the humus in some of the black soils of Indiana the authors found that the ammonia continued to extract coloring matter for a long time, the extraction requiring over a week in some cases. The ammonia percolated through duplicate samples of the same soil at different rates, and it was difficult to repeat a test under similar conditions, and uncertain when the extraction was ended. Consequently the following modification of the method was tried, "which has the advantage of keeping a definite amount of soil in contact with a definite volume of ammonia for a fixed time, the strength of the ammonia remaining constant and the air being excluded:"

The soil is washed with acid and water, as usual; the soil is then washed into a 500 c. c. glass-stoppered cylinder with 500 c. c. ammonia, the cylinder closed, and well shaken and allowed to remain for a definite time, usually thirty-six hours. The material is shaken at regular intervals. The cylinder is left inclined as much as possible without having the fluid touch the glass stopper, thus allowing the soil to settle on the side of the cylinder and exposing a very large surface to the action of the ammonia. During the last twelve hours the cylinder is placed in a vertical position to allow the soil to settle well before taking out an aliquot part of the solution.

To simplify the processes of washing with acid, water, and ammonia, an automatic washing apparatus was devised by which eight samples of soil could be treated simultaneously. The apparatus is figured in the bulletin and is described as follows:

The essentials of the apparatus are a large bottle to hold the washing solution, and a siphon to the lower end of which is attached a stopcock. To the lower end of this stopcock is attached, by means of a cork with a slot cut in the side, a glass tube 13 cm. long and 13 mm. in diameter. The lower end of this tube is closed by a rubber stopper, through which passes a glass tube of 2 mm. bore, which is turned back upon itself inside the larger tube, forming an intermittent siphon, which delivers about 6 c. c. of the fluid. The funnels containing the soils are placed immediately below the lower end of the siphon. By means of T tubes the washing fluid may be

delivered to as many samples as may be desired. The stopcocks are so adjusted that all the fluid may drain through the soil before the siphon fills and delivers another amount of the washing fluid. Instead of washing on the usual form of filter paper in funnels, we prefer with this apparatus to hold the soils on disks of filter paper resting on perforated porcelain plates placed in the funnels. The soil is covered with a disk of filter paper, and small pieces of glass rod are used to hold down this filter paper. This form of apparatus removes the necessity of washing out large filter papers, does not permit the accumulation of humus on the edges of the filter when the Grandeau process is used, and insures that all the washing fluid collected in the flask below shall pass through the soil and not around it. In all cases the acid passed readily through the soil.

The Grandeau and modified methods were compared on eight samples of soil of different kinds, using 2, 4, 7.3, and 8 per cent ammonia. The modified method gave much higher results than the original method, but subsequent treatment of the residue from the extraction with 2 per cent ammonia by the original method gave a further quantity of humus, making the results by the two methods very nearly the same when 2 per cent ammonia was used.

"In the soils not peat the strength of the ammonia makes practically no difference in the modified method, and comparatively little difference on peat soil when the strength is 4 per cent or over. In the Grandeau method there are wide differences, although this difference is not always in proportion to the strength of the ammonia."

A sample of peat extracted by the Grandeau method with 4 per cent ammonia continued to give up considerable humus after ten days. The extraction of peat soils was not complete with 2 per cent ammonia. For practical analytical work digestion for thirty-six hours with 4 per cent ammonia or stronger is deemed sufficient. The adoption of a standard temperature for the digestion is recommended. The results of duplicate determinations agreed much more closely by the modified than by the original method.

To ascertain whether the amounts of phosphoric acid, potash, etc., found in the ash of humus is necessarily associated with the humus, the phosphoric acid was determined in the ash of 50 samples of humus. The results failed to show any relation between the amount of humus extracted from the soil and the amount of phosphoric acid present. The same was true of thirty potash determinations.

"These substances happen to be extracted from soils by the same process as the humus; but it does not follow that they were associated with the humus before its extraction."

Preliminary investigations relating to the determination of crude fiber, H. A. Huston and W. F. McBride (*Indiana Sta. Bul. No. 46, Sept., 1893, pp. 80–85*).—The investigations reported include studies on the action on a number of feeding stuffs and on filter paper of 2½ and 1¼ per cent solutions of sulphuric acid and sodium hydrates, 2½ per cent hydrochloric acid, glycerin, a 4 per cent solution of borax, a solution of silicate of soda made by diluting 225 c. c. of commercial silicate of soda to 2 liters, carbonate of soda equivalent to 2½ per cent

sodium hydrate solution, bicarbonate of soda of same strength, and distilled water; and a few studies on the crude fiber obtained by different treatment. The summarized results of the use of different solvents on feeding stuffs here follow:

(1) Acid and alkali of 2½ per cent gave lower results in every case than 1¼ per cent acid and alkali.

(2) Practically the same results are obtained on these samples whether they are first extracted with ether or are directly treated with the acid and alkali. The fiber obtained by treating with 2½ per cent acid and alkali without previous extraction with ether was lighter in color than that obtained by the use of acid and alkali of the same strength after treatment with ether. In case of corn bran, however, the fiber obtained without extraction with ether contained fatty acids even after treatment with ammonio-cupric hydrate.

(3) Hönig's [glycerin] method has not proved satisfactory in our hands. The difference in duplicates is frequently very great even where the conditions are kept as nearly uniform as possible. The amounts of albuminoids left in the fiber are too great to be neglected. In every case where pentosans were present in the original material they were found in the fibér obtained by Hönig's method from that material. * * * The amounts of fiber obtained by this method are much higher than those obtained by other methods.

(4) The difficulties met with in using Hönig's method seemed to be due in great part to the presence of gums and starch. We therefore treated the feeding stuff with 1¼ per cent sulphuric acid before treating with glycerin. The results are much lower than by the use of Hönig's method alone; the amount of albuminoids in the fiber is much lower; the filtering and washing of the fiber are easily accomplished; and this modification of the method seems to remove many of the difficulties connected with the original method. It seems better to apply the acid treatment before applying the glycerin rather than after the glycerin treatment. * * *

(5) Treatment with dilute sulphuric acid and 4 per cent borax solution gives a lower amount of fiber than Hönig's method, and less albuminoids are present in the residue. The albuminoids are, however, higher than in the residues from sulphuric acid and glycerin. The method is very easily carried out.

(6) Silicate of soda was tried in the place of caustic soda. It has replaced caustic soda in large machine shops for cleaning the cotton waste, since it does not render the fiber brittle. In order to keep the silica in solution it is made quite alkaline. The results obtained with it on feeding stuffs give nearly the same results in fiber as borax or glycerin after preliminary treatment with dilute acid. The albuminoids are not completely removed. The method is as easy of application as the official method.

(7) Carbonate and bicarbonate of soda were tried in place of caustic soda on corn meal, oil meal, and clover hay. The bicarbonate foams badly and gives results high in both fiber and albuminoids. The carbonate works more satisfactorily, but it does not completely extract albuminoids, although on oil meal and clover hay it compares favorably with all other solvents except caustic soda.

(8) Borax alone was tried, but the results were too high in albuminoids.

(9) Silicate of soda was also tried on the clover hay without previous treatment with acid. The results were lower in both fiber and albuminoids than on treatment with borax alone.

(10) Doubling the strength of the solutions of silicate of soda and of borax had no effect in reducing the amount of fiber or albuminoids.

On filter paper the results were as follows:

(1) Water, glycerin, borax, hydrochloric acid 2½ per cent, and sulphuric acid 2½ per cent have comparatively little solvent action on the paper. Caustic soda and silicate of soda dissolve considerable quantities of the paper.

(2) Increasing the strength of the caustic soda solution causes more loss of fiber, although the increase is not great.

(3) With sulphuric acid, water, and borax an additional boiling for thirty minutes gave no increase in amount of paper dissolved. With caustic soda and glycerin a marked increase in solvent action resulted from increased time of digestion. With silicate of soda the material gelatinized before the one-hour digestion was completed. As the alkaline silicate of soda attacks the fiber vigorously, and as the product of treating cellulose with alkali is an acid, this gelatinization was probably due to separation of silicic acid.

(4) With a single exception (water followed by caustic soda) more fiber was destroyed when two solvents acted one after another on the same sample of pulp than the sum of the fiber destroyed by the same solvents acting on two separate portions of the pulp. This is very noticeable in the process used as our official method for fiber. * * *

(5) When a stream of hydrogen was substituted for the air blast a loss of 26.94 per cent occurred, against a loss of 16.68 per cent with air.

Examination of the crude fiber obtained by different treatment is in progress, but only a few results are reported.

Methods of physical and chemical soil analysis, E. W. HILGARD (*California Sta. Report for 1891–'92, pp. 241–257, fig. 1*).—Under this title is given a detailed account of the methods of soil examination followed at the California Station, including an illustrated description of the churn elutriator devised by the author for the mechanical analysis of soils.

Report of chemist of Delaware Station, C. L. PENNY (*Delaware Sta. Report for 1891, pp. 104–109*).—An account is given of a method worked out for the manufacture of milk sugar from skim milk (see Dairying, p. 605), together with very brief accounts of miscellaneous work, including a study of the variations in the volatile fatty acids of butter during the year, which has been undertaken, and a comparison of Leffmann and Beam's method of saponifying fats with the method in general use.

The result of the comparison is, briefly, that the new method with fresh butter gives results on the average a mere trifle lower than does the older method; with rancid butter, on the contrary, the deficit by the new method is considerable, too great to admit of intelligible comparison of the results of the respective methods. The new one will be found a much readier means of detecting oleomargarin than the older one, and for this reason it must be considered a valuable adjunct to analytical chemistry, even though it does not supplant the one now in vogue.

Analyses of rocks, clays, marls, etc., R. H. LOUGHRIDGE (*California Sta. Report for 1891–'92, pp. 76–79*).—This includes analyses, with comments, of miscellaneous samples sent to the station for examination, including various supposed minerals, limestone, marble, clays, salt sediment, marl, ashes, and Paris green.

Cost of chemical analyses at Texas Station (*Texas Sta. Bul. No. 27, June, 1893, p. 326*).—The schedule of prices charged at the station laboratory. The prices given are: Soils, $6; water, $6; fertilizers, $10; ores, for each metal, $1; and feeding stuffs, $6.

BOTANY.

WALTER H. EVANS, *Editor.*

The fixation of free nitrogen by plants, W. O. ATWATER and C. D. WOODS (*Connecticut Storrs Sta. Report for 1892, pp. 17–22*).—An account of experiments on the acquisition of free nitrogen by peas, in continuation of those described in the Annual Reports of the station for 1890 and 1891 (E. S. R., vol. III, p. 374; IV, p. 14). It was intended to obtain light on the way by which the nitrogen is obtained, whether through the leaves or roots or both, but circumstances prevented the complete carrying out of the proposed plans of the experiments. The plants were grown in cases resembling Wardian cases in the greenhouse under conditions as nearly normal as possible, but with the exclusion of all combined nitrogen in air, soil, or nutritive solutions, except the small quantity contained in the seed and in the inoculation material. The details of construction of the apparatus and methods of conducting the experiments are given. The experiments were conducted for eighty-five days. At the end of this time the 27 plants had made a growth of from 21 to 43 inches in height, with an average of 29 inches. The root development of 14 was designated as good, 9 as fair, and 4 as poor. The tubercle development of 10 was good, and of 10 fair; 4 developed few, and 3 very few, tubercles. A total gain of 242 mg. of nitrogen, with an average of 9 mg. for each plant, was made. As a rule the largest gains were recorded for those plants having the best tubercle development. "The free nitrogen of the air was alone available to the plants, and the gain must have been by the acquisition of free nitrogen."

University botanic garden, E. L. GREENE (*California Sta. Report for 1891–'92, pp. 166–168*).—Brief statements concerning the botanic garden of the University of California established in 1891.

BACTERIOLOGY.

The isolation of rennet from bacteria cultures, H. W. CONN (*Connecticut Storrs Sta. Report for 1892, pp. 106–126*).—The author reviews and summarizes the literature relating to bacteria and the formation of enzymes capable of producing certain fermentations. He has been engaged in isolating the enzyme of rennet from bacteria cultures, although as yet has not obtained it in a pure condition. The species used were normal bacteria of milk obtained from a creamery near the station. From the many species obtained from ripening cream seven were selected as seeming to have the rennet-forming power well developed, and cultures were made of them. The different species of bacilli

are described. The demonstration of the presence of the ferment and its isolation was made as follows:

For this purpose one of the organisms, No. 5, was inoculated into an Erlenmeyer flask containing sterilized milk. In this the bacteria were allowed to grow for nine days at the normal temperature of the room (about 20° C.). At the end of that time the milk had become curdled by the action of the rennet, and the curd was partially dissolved. A small amount of water was then added to the culture in order to make the amount of liquid a little greater, and to assist in the solution of the enzymes and render filtration easier, and then the whole was filtrated through a porcelain cylinder. A small amount of this filtrate was put into a test tube containing sterilized milk and the tube placed in a culture oven at a temperature of 37° C. The milk in the tube became curdled in less than two hours. A gelatin culture was then made from the curdled milk in order to determine whether by any accident the filters had not worked successfully and the bacteria had found their way into the filtrate. The gelatine culture showed no growth, and thus it was demonstrated that the curdling in this case must have been due to some soluble ferment in the filtrate. Parallel with this experiment, a second was conducted in a similar way, except that the organism was cultivated in beef peptone bouillon instead of milk. The filtrate from this culture obtained from the porcelain cylinder did not, in the first experiment, show any power to curdle milk.

Having thus shown the presence of a soluble enzyme in the filtrate, the next problem was to isolate it from its solution. For this purpose the same organism was again cultivated in sterilized milk, filtered at the end of two weeks through a porcelain cylinder, and the filtrate treated with a large amount of strong alcohol. There appeared an abundant precipitate. The precipitate was then allowed to stand under the alcohol for two weeks, in a closely stoppered bottle. At the end of that time the precipitate had settled to the bottom of the alcohol and the alcohol was easily decanted from it, leaving the clear precipitate at the bottom. This precipitate was then dissolved in sterilized water. The precipitate dissolved completely. A small amount of this solution was then added to a test tube of sterilized milk and placed at 37° C. The milk was curdled in one and one half hours. The curdled milk was allowed to stand at 37° C. for two days, to see if the curd became digested. No digestion of the curd made its appearance. The rest of the water solution was again treated with alcohol, which once more precipitated the enzyme. The alcohol was then filtrated off and the precipitate collected and dried. It was thus obtained in the form of a grayish hard mass, which was found to still retain the power of curdling milk when dissolved in water. This material was kept for several weeks in the laboratory and tested at intervals with like results. The curdling of the milk under the influence of the material was rather slow, requiring sever 1 hours' action, and from this the conclusion was reached that the rennet existed in this precipitate only in small quantities and by no means in a pure state.

Having obtained the rennet from one species of *Bacillus*, similar experiments were conducted with the other species, and in all cases it was possible to obtain an amount of rennet ferment from the culture after the organism had grown in it for the proper length of time. Considerable variation was shown as to amount of the ferment and the readiness with which it would coagulate milk. From various experiments it became plain that the alcoholic precipitate was not pure, but contained the tryptic ferment of Fermi. The rennet ferment may be partly separated by the use of salt, although by no means completely. From additional experiments it was found that the bacteria rennet is destroyed by a temperature varying from 70° to 80° C.

The author summarizes his report as follows:

(1) Many species of bacteria that have the power of liquefying gelatin produce, as a result of their growth in milk, a certain quantity of an enzyme which, so far as can be at present determined, has all the essential characteristics of rennet.

(2) This rennet can be isolated from bacteria cultures by filtering the cultures through a porcelain cylinder and then treating the filtrate with alcohol. A better method, which gives the rennet in a purer condition, though by no means pure, is to precipitate it from its solution by an excess of salt instead of alcohol.

(3) It has been found possible to isolate this rennet from milk in the case of all species of bacteria thus far studied which curdle the milk without rendering it acid.

(4) Different species of bacteria differ very much in the amount of rennet which they produce and the rapidity with which they produce it.

(5) Several species of bacteria have been found to produce rennet in considerable quantity, even where they are not capable of curdling the milk. The explanation of the fact is that the production of a tryptic ferment obscures the production of the rennet ferment in these cases, and the casein becomes peptonized before it can be precipitated by the more slowly forming rennet.

(6) The organisms experimented upon seemed in every case to produce a larger amount of rennet when growing at a moderately low temperature than when growing at a temperature of 35° C.

(7) The rennet, isolated in this way, has all of the general reactions of dairy rennet, and is subject to destruction by high temperatures in a similar manner.

METEOROLOGY.

W. H. Beal, *Editor.*

Meteorological observations at Connecticut Storrs Station, C. S. Phelps, E. A. Bailey, and S. H. Buell (*Connecticut Storrs Sta. Report for 1892, pp. 57–59*).—Summaries of observations on temperature, pressure, precipitation, cloudiness, and wind movement for each month of 1892 at the station are given, together with tabulated results of observations on rainfall from May to October at 26 localities in the State, furnished partly by the New England Meteorological Society and partly by persons conducting field experiments in different parts of the State under the supervision of the station. The following annual summary is prepared from the monthly means: *Pressure* (inches)—highest 30.92, October; lowest, 29.15, February; mean, 30.03. *Temperature* (degrees F.)—highest, 92, July; lowest, 1, December; mean, 46.3. *Humidity*—mean relative, 77.8. *Precipitation* (inches) total, 36.28; number of days on which 0.01 inch or more of rain fell, 100. *Weather*—number of clear days, 124; of fair days, 126; of cloudy days, 116. *Wind*—total movement, 79,742 miles; maximum velocity, 60 miles per hour, January and March.

The rainfall for the year (36.3 inches) as measured at the station is much below the average. Six stations of the New England Meteorological Society having records covering a period of ten or more years previous to 1890, give an average annual precipitation of 49.1 inches. The records of this station for the three years prior to 1892 give an average of 50.3 inches.

The precipitation was smallest during the months of February, April, September, and October. The rainfall for April (0.70 inch) was the smallest for any month in the year. This prevented an early start in the grass crop and no doubt lessened the

yield considerably. During the portion of the year when most crops were developing (May–August) the rainfall was about the average, so that farm crops as a rule were not greatly injured. Springs and wells, however, have rarely been known as low as in October.

The temperature for the first three months of the year was a little below the average, while the snowfall was light. April gave about the average temperature and the spring opened quite early. The last damaging frost occurred April 30. The weather during the months of May and June was favorable for nearly all farm crops. The summer was unusually warm and conditions were favorable for harvesting the hay crop.

The first killing frost occurred September 21. This gave a growing period of 144 days, since the last damaging frost in the spring. The average growing season for the past five years at Storrs is 142 days. The shortest period, 114 days in 1888, and the longest, 164 days in 1891.

September and October were characterized by unusually dry weather. Pastures were injured and all fall maturing crops suffered. The rainfall for November, however, was above the average, and wells and springs were generally replenished.

Meteorological observations at the Delaware Station, W. H. Bishop (*Delaware Sta. Report for 1891, pp. 109–124*).—Monthly summaries of observations at six stations in the State on temperature, pressure, and rainfall are tabulated and briefly discussed. A summary for the year is given in the following table:

Annual summary of meteorological observations in Delaware.

	Newark.	Middletown.	Dover.	Milford.	Seaford.	Millsboro.
Temperature (degrees F.):						
Highest	93 (June 16, 17; Aug. 10, 11).	95 (June 17, July 25, Aug. 10, 11).	97 (June 16).	94 (July 30).	96 (Aug. 10).	94 (Aug. 10)
Lowest	10.5 (Mar. 2).	11 (Mar. 2).	15 (Feb. 5, Mar. 2, Dec. 18).	14 (Feb. 5)	12 (Nov. 30)	6.5 (Dec. 1)
Mean	52.9	54.6	54.4	55.6	54.9	54.7
Rainfall (ins.):						
Total	50.86	52.71	54.14	56.19	56.66	69.43
From Apr. 1 to Nov. 1	28.31	26.30	27.73	29.95	30.93	42.36
Greatest monthly	8.33 (July)	7.30 (Jan.)	9.42 (July)	8.44 (July)	12.18 (July)	12.62 (July)
Least monthly	1.53 (Nov.)	1.41 (Sept.)	1.04 (Nov.)	1.50 (Sept.)	0.50 (Sept.)	1.65 (June)
Number of days on which 0.01 inch or more rain fell	113	103	108	104	100	130
Pressure (ins.):						
Highest	30.83				30.84.	
Lowest	29.25				29.24.	
Mean	30.07				30.08.	

The rainfall for the year has been above the average, although not as great as that for 1889. * * * Throughout the State, July was a very wet month. The driest months were in the fall—September and November. * * * On the whole the rainfall was well distributed through the year and was favorable to crops.

The average temperature for the year varies but little from the normal, being rather less than the average for a term of years. No excessively high temperatures are reported. * * * Neither do we find that there was any unusually cold weather. * * * The first killing frost in the fall was on October 29. * * *

As will be seen, the difference in barometric pressure between the northern and southern portions of the State has been very slight. The range for the year was 1.6 inches at Seaford and but 0.025 of an inch less at Newark.

WATER—SOILS.

W. H. BEAL, *Editor.*

Analyses of waters, E. W. HILGARD and R. H. LOUGHRIDGE (*California Sta. Report for 1891–'92, pp. 50–75*).—The mineral constituents, with occasional sanitary analyses, are given for 14 samples of lake and stream water, 14 of spring water, 27 of well water, and 6 of artesian water, and the value of the different waters either for irrigation or domestic purposes is discussed.

Geology of the Wyoming experiment farms and notes on the mineral resources of the State, W. C. KNIGHT (*Wyoming Sta. Bul. No. 14, Oct., 1893, pp. 103–212*).—This is a preliminary report intended to prepare the way for future investigations, and presents general conclusions regarding the geological origin and proper classification of the soils of the six experiment farms of the station.

The rock masses which have been decomposed and eroded to form the soils of the State have not been critically examined nor their various constituents determined so that any formation might be classified as beneficial or detrimental to good soil-making. The various geological formations which have entered into the soils of Wyoming range from Archæan to the Pliocene Tertiary, and the methods of decomposition, pulverizing, eroding, and transportation include all known phenomena.

A study of the soils of Wyoming is especially interesting, owing to the diversity of composition. Some of them have been derived from the entire series of rocks ranging from Archæan to the close of the Tertiary, while others are the result of the decaying of a single geological horizon. There are many subjects of importance relative to the soils of the State which will receive attention hereafter. Chief among them are the following: (1) The cause of the decomposition of rock masses; (2) climatic action upon rock masses; (3) water erosion over various grades and the resulting soils; (4) wind erosion.

Wind erosion plays an important part in the transportation of soils in Wyoming, and beyond a doubt has in the past, owing to the incoherent state of the soils, due to the lack of clay. The arid regions of Wyoming, which are chiefly Tertiary and Cretaceous plains and table-lands, receive very little rain. Consequently the soils become loosened by great earth cracks and during the dry and windy winter weather are transported in dense clouds, which almost suffocate travelers, to the broken country and distant hills and mountains. In a single season it is not an uncommon sight to see banks of earth, like huge banks of snow, behind a reef of rock or in the lee of large bunches of sagebrushes.

The Laramie farm (pp. 105–107).—This farm is located 2 miles southwest of Laramie upon prairie land 7,200 feet above the sea level, and "probably is the highest experiment farm in the United States."

Geologically the Laramie farm is located on Dakota group (Cretaceous) sandstone, very near the junction of the Cretaceous and Jurassic. * * *

Glaciers were instrumental in making the greater portion of the soil of the Laramie plains. * * *

The glaciers in moving down the valleys ground up Archæan, Paleozoic, and Mesozoic rocks and conveyed them to the plains for soil-making, Following the glacial period was one in which a calcareous deposit formed over the glacial boulders, after which the erosion of the waters and winds completed the soil-making of the

plains. I should not say completed, for not a single windstorm sweeps these plains or not a rainstorm causes the tiniest rill but the work of erosion goes on, and soil-making continues as it has for these thousands of years.

According to Hilgard's classification of soils the Laramie farm would be called a colluvial, but rich in the life-giving elements and capable of long and heavy tillage with but little assistance from fertilizers.

The Lander farm (pp. 108–110).—The Lander farm is located in the valley of the Popo Agie River 5,500 feet above the level of the sea and 5 miles south of Lander in a region of rich table and valley lands. It rests upon the Lower Triassic rocks in a cove-like basin which has been cut out by glaciers, and the material entering into its soil has come principally from the rocks of this formation. "The red sandstones and clays decomposed and in time covered a portion of the present farm." A ledge of marble, encountered in the Triassic rocks, also contributed largely to the soil formation. "The soil is a colluvial and is not only rich but warm and capable of producing crops that would not mature on a rich black alluvial at this altitude."

The Saratoga farm (pp. 110–112).—The soil of this farm resembles that of Laramie in composition and of Wheatland in geological position. It rests upon Pliocene rocks, but is composed of material from the Archæan, Paleozoic, Mesozoic, and Cenozoic rocks located above the valley, ground up by glaciers and transported to its present position by the Platte River. The soil is, therefore, a rich alluvial.

The Sheridan farm (pp. 112–114).—This farm is situated about 1 mile southwest of the town of Sheridan, at an elevation of 3,750 feet.

It is located upon middle Laramie group (Cretaceous). The soil has been derived from Archæan (?), Paleozoic, and Mesozoic rocks which have been disintegrated and carried down Little Goose Creek. Owing to the nature of the soil and being in the valley it is called an alluvial. There were no fragments or pebbles associated with the soil, which is rich in necessary plant food and better capable of holding moisture than most of the other stations in the State.

The Sundance farm (pp. 114–115).

The Sundance farm is located 1 mile southeast of Sundance in a valley between Sundance and Green Mountain, at an elevation of 4,750 feet above the sea level.

The country about is mainly a rolling and broken prairie, with occasional low detached mountains and hills. * * *

It is located on Upper Triassic sandstone. * * *

The soils of the farm have been derived from eroded and decomposed Triassic and Jurassic rocks, which have not been transported any great distance. These rocks are composed of ferruginous sandstone, chiefly, though they contain some limestone, clays, and marls. The decomposition and erosion have been so gradual and so perfect that no fragmentary rocks are to be found. The soil partakes in color of the adjacent formation and is a colluvial, resembling the soil of the Lander station.

The Wheatland farm (pp. 116–117).—The Wheatland farm is located in the northern portion of Laramie County "almost under the shadow of the famous old landmark, Laramie Peak." It rests upon a Pliocene formation. The soil is a colluvial derived from Archæan and Pliocene rocks without the assistance of glaciers.

The Wheatland and Saratoga farms are located upon the same geological horizon; but owing to the different formations entering into the soil composition in the two

vicinities, their soils are of different natures. This evidence leads me to believe that one can not say that this or that geological horizon is best adapted to certain lines of cultivation. In each and every instance when the question of geological position arises, in the selection of land, the first and all-important question to be settled is from what geological formations the soil was derived, and not upon what formation it rests. For example, in many places in Wyoming rich and extensive agricultural districts rest upon Cretaceous and Tertiary formations that in themselves are detrimental to good soil-making.

The report closes with a tabulated statement showing the geological horizons of the different experiment farms, and giving the names of the various geological formations which enter into the composition of the soil.

A general discussion is given of the mineral wealth of the State, based upon data secured in an inspection during the last four months of nearly every important mineral locality in the State.

Upon Wyoming's mineral wealth depends the growth and prosperity of the State. * * *

Industries are needed which will open the mines and employ an army of workmen. This must be done before the agricultural interests will reach the standard they should, for the farmers in Wyoming can not raise grain and produce and expect to dispose of them in any of our border States, which are well supplied with home products. The only way to obtain a market is to make one, and the way to accomplish this is to utilize the minerals which nature has seen fit to store in these mountains, hillsides, plains, and valleys.

Wyoming contains 62,645,120 acres of land, 10,000,000 of which are suitable for agricultural pursuits. Of the remaining 52,000,000 acres there are 22,000,000 acres of mountains and 13,000,000 acres of coal land. * * *

In this great extent of mineral-bearing country there have been discovered gold, silver, copper, lead, coal, iron, petroleum, soda, asbestus, plumbago, gypsum, mica, tin, and a score or more of other valuable minerals.

Soils and fertilizers, A. A. PERSONS (*Florida Sta. Bul. No. 20, Sept., 1893, pp. 23*).—This is a popular bulletin discussing the following topics: The development of scientific agriculture; relation of chemistry to agriculture; definition of a soil, etc.; mechanical classification of soils; chemical composition of soils; general description of soil elements; definition of manure; composition of manures; home-made manures; commercial fertilizers; sources of phosphoric acid, potash, and nitrogen in fertilizers; explanation of a chemical fertilizer analysis; and how to estimate the market value of a fertilizer.

Reclamation tests with gypsum on alkali soils, R. H. LOUGHRIDGE and C. H. SHINN (*California Sta. Report for 1891-'92, pp. 80-90*).—These tests were made at the substation near Tulare on a piece of land so strongly charged with alkali that "crystals of carbonate of soda glistened upon the surface, and the black humus spots so characteristic of alkali were very prominent." Two layers of alkali hardpan occurred within two feet of the surface, and no vegetation would grow on the soil. In the center of a fourth-acre plat of this soil a drainage pit was dug and lined with boards, and three board drains running across the plat were made to empty into it. "The plan pro-

posed was, in brief, this: To make a slight embankment around the experiment plat, to sow the plat with gypsum or land plaster, and cover it with water, which should gradually pass down into the drains and carry off much of the alkali into the general drainage system of the country."

To summarize briefly, the treatment was as follows: November 2 the land was plowed and 500 pounds of land plaster applied, or at the rate of one ton to the acre. The water pumped onto it was about 50,000 gallons. The drains were plugged for three or four days. November 9 the "crust" was broken and more water applied, but no plaster. November 16 more water, about 25,000 gallons, was applied. The water sank along the line of the drains and ran out immediately. The drains were stopped, and the hardpan again broken up. November 24 more plaster (150 pounds) was put on the upper half of the plat; none on the lower half. For the subsequent week, more water was added, and the worst places were broken up. November 27, 150 pounds of plaster were used on all the bad spots of the tract, a shovelful here and there. December 4, 100 pounds of plaster was used in the same way. This makes a total of 900 pounds on the quarter acre, or at the rate of 3,600 pounds to the acre. This seems a large amount, and at the present price of plaster the job was rather an expensive one; but plaster can be obtained in the foothills, and supplied to the San Joaquin valley at a price which will justify the use of two or even three tons per acre, provided that it accomplishes the desired results.

In order to ascertain the changes brought about in the soil by this treatment, samples of drainage water obtained at each irrigation were taken and analyzed. The results show that during the period of treatment fully one half of the carbonate of soda originally indicated by the drainage water had been converted into sulphate of soda and removed from the soil.

Analyses of the soil from depths of 1, 3, and 6 feet, before and after the above treatment, were also made. These show that "the treatment reduced the entire salts to about 24 per cent of what was in the natural soil; the leaching and drainage carried off about 83 per cent of the sulphates of soda and potash, and about 85 per cent of the chloride of soda of the natural soil. We also find that the gypsum and leaching with water changed to sulphate and carried off about 65 per cent of the carbonate of soda."

At the end of the treatment with gypsum, as described above, seeds of a number of plants were sown, with the following results:

Japanese buckwheat grew very well until it attained a height of about a foot, when the plants burned and wilted in the sun. It does poorly in this district at the best. Barley, planted late, in the center of the spot, did fairly well, a portion making heads, and all the stalks being at least 18 inches high. Six varieties of sorghum all did very well, everything considered. Some made stalks 6 feet high, and if the entire plat had been sown to sorghum it would have been profitable. Sugar beets made a very poor showing.

It is evident from the above tests that a percentage of "black alkali" even as low as 0.05 is too much for the full growth and maturity of our ordinary field crops, and that one tenth of 1 per cent is very destructive to the young plant if not to the seed itself.

Analyses of alkali in different layers of the soil experimented on are tabulated, and notes on several samples sent to the station for examination from different localities are added.

Analyses of soils, R. H. LOUGHRIDGE (*California Sta. Report for 1891–'92, pp. 24–48*).—Chemical analyses of 8 samples of soils sent to the station for examination from the Foothills, Coast Range, and Southern California regions are given, together with descriptions of the samples of soil and comments on their agricultural value; and mechanical analyses, with comments, and observations on water-holding capacity and hygroscopicity of 10 samples derived from similar sources.

Determination of organic nitrogen in soils, M. E. JAFFA (*California Sta. Report for 1891–'92, pp. 48, 49*).—The results of an examination of 4 soils, to ascertain whether there is any definite relation between the organic nitrogen in soils and the humus, are tabulated. The humus was determined by Grandeau's process and the organic nitrogenous matter was separated and analyzed by the following method:

The soil is first treated as in the case of humus determination—that is, 5 or 10 grains are leached, in the cold, with dilute hydrochloric acid (0.5 to 1 per cent) until all the lime is extracted. It is then completely washed, and in place of using ammonia, a 5 per cent solution of potassic hydrate is added to the washed soil on the filter. This treatment with potassic hydrate is continued until the solution, upon passing through the filter, is colorless.

This extract, or an aliquot thereof, is acidified with pure sulphuric acid and the nitrogen determined by the Kjeldahl method. * * *

The data thus far ascertained is not sufficient to warrant drawing any conclusions, but the completion of the examinations now under way, and soon to be published, may tend to elucidate this interesting subject to a very great extent.

FERTILIZERS.

W. H. BEAL, *Editor.*

Fertilizer inspection and analyses in New Jersey, E. B. VOORHEES, L. A. VOORHEES, and J. P. STREET (*New Jersey Stas. Bul. No. 97, Nov., 1893, pp. 43*).—This bulletin contains the analyses and commercial valuations of 248 samples of different brands of manufactured complete fertilizers, and 51 of incomplete fertilizers, which include ground bone, dissolved bone, wood ashes, and miscellaneous products.

The results are discussed under the following heads: Inspection of fertilizers, commercial valuation, and composition and valuation of complete fertilizers, bone, and miscellaneous fertilizing materials.

It is the aim of the station to secure a sample of all the different brands and fertilizer products upon the market. It is believed that this aim has been practically attained this year; the number of brands of complete fertilizers is nearly 20 per cent greater, while the number of those of a miscellaneous character is quite as great as in any previous year. This result is due both to a closer inspection and to the fact that new brands are constantly introduced, the product of both old and new firms. * * *

While the multiplication of brands is not on the whole to be commended, a point worthy of consideration is shown, viz, that where dealers have brands made to their order by regular manufacturers the quality is always good and the commercial value is much nearer the selling price than those sold direct by the manufacturer himself. * * *

The average composition, selling price, and commercial valuation of complete fertilizers for 1892 and 1893 are shown in the following tabulation:

Composition, cost, and valuation of complete fertilizers.

	Total nitrogen.	Total phosphoric acid.	Available phosphoric acid.	Insoluble phosphoric acid.	Potash.	Selling price.	Station valuation.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*		
1892	2.74	10.38	7.70	2.67	4.50	$34.19	$25.66
1893	2.69	10.23	7.54	2.69	4.58	34.11	24.41

The average composition and selling price per ton are practically identical with those of last year, while the valuation this year is $1.25 less than in 1892, making the difference between valuation and selling price $9.70, or the selling price 40 per cent greater than the valuation, which represents the average charges per ton for mixing, bagging, and selling. It is evident that the decrease in the cost of fertilizer supplies has not resulted in a lower selling price per ton for the mixtures made from them by the manufacturers. It is shown, too, from a study of the tables, that the difference between valuation and selling price in nearly half of the brands is above this average, ranging from $10 to $25 per ton, thus giving a wide opportunity for selection on the part of the purchaser. * * *

The samples of ground bone examined this year are, on the whole, of good character. A criticism made prominent in previous discussions of the analyses of bone products, however, still holds good, namely, that the trade terms, bone meal, pure bone, steamed bone and raw bone, bear no exact relation to the kind of bone, nor do they indicate the method of manufacture. * * *

This year the value of the nitrogen in the coarser grades is reduced one half cent per pound, while phosphoric acid is reduced in all cases except the coarser grade. The average per cent of fineness is this year an improvement over that secured in 1892. The average selling price per ton, excluding those samples not comparable, is $32.50, and the average valuation $31.23 per ton.

The analyses of samples of dissolved bone are shown to be of good quality. The commercial valuations of three out of the five samples bought in the usual manner, by the ton, are within $3 of their selling price. * * * Dissolved bone is an excellent fertilizer for wheat, and at the present low price of the cereal it is of the greatest importance that farmers should take advantage of such opportunities as are afforded by these products to reduce the cost of the crop. * * *

The samples of wood ashes examined this year were, with two exceptions, below the average quality. The schedule of values adopted for ashes is 5 cents for phosphoric acid and 5½ for potash. The average cost per pound for potash and phosphoric acid contained in these samples [excluding one sample] is 9.7 and 10.7 cents, respectively. When the agricultural value of wood ashes is recognized, it is a question whether farmers do well in purchasing phosphoric acid and potash in this form at the prices named.

Fertilizer inspection and analyses in Rhode Island, H. J. WHEELER and B. L. HARTWELL (*Rhode Island Sta. Bul. No. 26, Nov., 1893, pp. 127–138*).—This includes tabulated analyses, with valuations, of 42 samples of fertilizing materials examined in 1893, including compound fertilizers, muriate of potash, nitrate of soda, and ashes; a table showing the firms selling complete fertilizers in the State during 1893, the number of brands analyzed, and the relation of the guaranties to the amounts of nitrogen, phosphoric acid, and potash found by analysis;

comments on particular analyses; and remarks on the selling price and valuation of fertilizers in 1893.

By a comparison of the table [of analyses for 1893] with similar ones for 1891 and 1892 it will be seen that the goods which have been sold in the State this year have not been so generally equal to the guaranties as was the case last season; they give, however, a somewhat better showing than those of 1891. * * *

In the case of 74 brands of complete fertilizers sold in the State this year the average selling price has been $35.79, and the average commercial valuation $23.79, making an average difference of $12 per ton. This difference for 1892 amounted to $9.43 and in 1891 to $9.61. The average selling price in 1892 was $35.80, or one cent more than this season, and the greater difference between selling price and valuation this year is due to two circumstances: (1) The fertilizers sold this season were not as good compared to their guaranties as those of 1892. (2) The schedule of prices used in estimating the commercial valuation, which is based upon the retail price of the stock used in making the goods, is somewhat lower in some instances than last season. We are convinced, however, that our basis of valuation for the year has been a just one, from the fact that it is in full accord with retail quotations on fertilizer stock, which have been made to farmers themselves. * * *

The manufacturer who hopes to succeed in business does not necessarily purchase all of the crude stock used in his factory from one firm, but he buys each kind of material where it can be bought cheapest. Our farmers ought, in similar manner, to secure quotations on fertilizer stock from a number of dealers in various sections and then buy each constituent where it can be purchased most economically. By resorting to practical business methods a great saving might be effected. By reference to the Rhode Island State Census for 1885, pages 516 and 517, it will be seen that the value of the fertilizers used in the State that year amounted to $164,133, and there is no question but that the amount at the present time is even much greater. Taking the figures for 1885, however, as a basis, and accepting the fact that the farmers of the State could have made a cash saving of about 33 per cent on the cost of their fertilizers the past season by purchasing their crude stock even at retail, it will be seen that over $54,000 might have been saved, or more than 3½ times the amount given by the Government for the annual support of this station.

Results of experiments with fertilizers on different classes of soils, C. S. PHELPS (*Connecticut Storrs Sta. Report for 1892, pp. 67–84*).—The author summarizes the results of about 90 soil test experiments with fertilizers on corn and potatoes made in Connecticut and other New England States during the past fifteen years, either under the direction of W. O. Atwater or of the Connecticut Storrs, Massachusetts Hatch, and Rhode Island Stations.

"The plan of experiments for these soil tests consisted in applying, on parallel plats of land, fertilizers containing nitrogen, phosphoric acid, and potash, singly, two by two, and all three together. The fertilizing materials were in all cases supplied * * * in standard commercial forms, and consisted of nitrate of soda, dissolved boneblack, muriate of potash, and land plaster. * * *

"The results have been summarized and tabulated in two groups: (1) Soils ranging from sandy to loam, and (2) soils ranging from heavy loams to heavy clays."

The following table gives the average yield from different fertilizing ingredients in 27 experiments with corn and 14 with potatoes, con-

ducted in different parts of New England during the years 1878–1881, and of 30 experiments with corn in Connecticut during the years 1888–1891:

Average yields per acre of shelled corn and of potatoes from the use of different fertilizing ingredients.

	Nitrogen.			Phosphoric acid.			Potash.		
	With.	Without.	Gain or loss.	With.	Without.	Gain.	With.	Without.	Gain.
Corn:									
Light soils:	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*
1878–1881	38.7	33.8	4.9	39.5	32.9	6.6	38.6	34.0	4.6
1888–1891	30.8	24.5	6.3	27.9	27.8	0.1	31.8	23.0	8.8
1878–1891	35.4	29.9	5.5	34.7	30.7	4.0	35.8	29.5	6.3
Heavy soils:									
1878–1881	32.5	32.0	0.5	38.2	24.7	13.5	32.6	31.6	1.0
1888–1891	25.6	26.8	—1.2	30.9	19.8	11.1	26.5	26.1	0.4
1878–1891	29.4	29.2	0.2	35.0	22.5	12.5	29.9	29.2	0.7
Potatoes:									
Light soils, 1878–1881	98.9	92.9	6.0	106.2	85.2	21.0	106.2	85.0	21.1
Heavy soils, 1878–1881	128.4	121.7	6.7	150.2	98.9	51.3	137.9	112.2	25.7

The experiments thus far made indicate that for corn on the lighter soils of the State fertilizers containing a large proportion of potash are needed to give the best results, * * * and that fertilizers with relatively large proportions of phosphoric acid produce the best results on heavy, clayey soils.

The results of coöperative experiments during recent years at the Massachusetts Hatch and Rhode Island Stations are also summarized.

The general conclusions drawn from this review of experiments with fertilizers on New England soils are as follows:

Soils can not be cultivated to the greatest profit without a knowledge of their deficiencies as regards plant food. Soil tests with fertilizers seem to be the best practical means for ascertaining these deficiencies in particular soils.

Heavy, clayey soils need to be supplied with large amounts of phosphoric acid in the fertilizers used, while light, sandy to loam soils are more generally, though not uniformly, helped by potash fertilizers.

The teachings of the experiments thus far made in Connecticut indicate that nitrogen is not beneficial on the light class of soils. Soluble fertilizers, as nitrate of soda and sulphate of ammonia, can generally be used with profit on light loam soils, but do not prove of much value for corn on heavy soils. For heavy soils nitrogen should be supplied in some organic form, as stable manure, dried blood, etc.

The wide differences found in soils afford a strong argument in favor of home-mixed fertilizers. The special needs of different soils can not be considered by the manufacturer who prepares his fertilizers for general use. The farmer may, however, prepare such mixtures as will meet the deficiencies of his soil and the requirements of his crops.

Coöperative field experiments with fertilizers, C. S. PHELPS (*Connecticut Storrs Sta. Report for 1892, pp. 85–105*).—The experiments of 1892 were conducted on essentially the same plan as that followed in previous years (E. S. R., vol. IV, p. 27), and include soil tests with fertilizers on corn in eight different localities in the State and one special nitrogen test on oats.

Full data relating to yield, percentage of dry matter in the corn, and number of pounds of ears required for a bushel of shelled corn

obtained in the soil test experiments are tabulated and discussed. This being the fifth year of experiments of this kind, the results furnish in many cases more or less conclusive indications of the special needs of the different soils for corn.

The object of the special nitrogen experiments conducted during the past year on grass (see p. 579) and on oats are stated to be "to study the effect of larger and smaller quantities of nitrogen on different crops, while the amount of mineral fertilizers remains constant. There are two prominent points to be considered—the effect of the fertilizer on the yield, and the effect on the composition and feeding value." Four plats of light loam soil received mixed minerals (dissolved bone-black 320 pounds and muriate of potash 160 pounds per acre), 3 mixed minerals combined with amounts of nitrate of soda varying from 160 to 480 pounds per acre, 3 mixed minerals with 200 to 600 pounds of dried blood, and 2 remained unmanured.

Data relating to amount and cost of fertilizers used and yield of oats on the differently manured plats are tabulated.

The mixed mineral plats gave but little increase over nothing. * * * The addition of 160 pounds of nitrate of soda to the minerals increased the yield of grain 9 bushels and of straw 675 pounds, at an increased cost of $4 for the fertilizers. The nitrate of soda gave a much larger increase than dried blood, while the cost of the two mixtures are practically the same. The extent to which nitrogen can be profitably used is not clearly shown in this experiment, owing to the lodging on 2 plats.

Soil and crop tests with commercial fertilizers.—A. T. NEALE (*Delaware Sta. Report for 1891, pp. 20–22*).—Fertilizer experiment on peach trees, sweet potatoes, corn, wheat, and potatoes, for which no detailed data are given.

Analyses of fertilizing materials, R. H. LOUGHRIDGE (*California Sta. Report for 1891–'92, pp. 129–134*).—Analyses of a number of samples of fertilizing materials, including sewage sludge, bat manure, guano, fish guano, dissolved bones, and gypsum, sent to the station for examination, are given with comments.

FIELD CROPS.

J. F. DUGGAR, *Editor.*

The cost of farm crops, C. L. INGERSOLL and S. W. PERIN (*Nebraska Sta. Bul. No. 29, April 15, 1893, pp. 35–42*).

Synopsis.—A record of the cost and profit in growing rye, oats, wheat, corn, and hay on the station farm in 1892. The cost of planting and harvesting per bushel was as follows: Rye, 39.8 cents; oats, 17.7 cents; five varieties of wheat, 23.4, 19.4, 16.6, 26.4, and 27.6 cents; corn on different fields, 23.43 and 14.9 cents. The cost of growing timothy and clover hay on three fields was only $1.34, $1.32, and $0.84 per ton.

The fields varied in area from 1 to 35 acres and the crops were treated substantially according to prevalent practice in the State. Labor was

uniformly charged at the rate of $3 per day for man and team. Taxes and interest were not reckoned among the expenses. Land was valued at $25 per acre. The selling price of rye and wheat was 50 cents per bushel, of oats and corn 30 cents per bushel, and of hay $3 per ton. The most important data are given in the following table:

Cost and profit in growing rye, oats, wheat, corn, and hay.

	Cost of planting and harvesting, per acre.	Yield per acre.	Cost per bushel in granary.	Cost of marketing.	Profit per bushel.	Profit per acre.	Interest on value of land.
		Bushels.					*Per cent.*
Rye	$8.50	21.33	$0.398	$0.020	$0.0820	$1.75	7.0
Oats	6.15	34.84	0.177	0.015	0.1070	3.75	15.0
Wheat:							
Ironclad	6.13	26.66	0.234	0.020	0.2500	6.66	26.0
Tuscan Island Red	6.45	33.07	0.194	0.020	0.2860	9.45	37.0
Hickman	6.83	40.75	0.166	0.020	0.3140	12.77	51.0
Extra Early Red	10.32	39.00	0.264	0.020	0.2160	8.40	33.0
Landreth White	10.00	36.17	0.276	0.020	0.2030	7.36	29.0
Corn:							
Centennial White	10.17	43.40	0.234	0.035	0.0307	1.33	5.3
Leaming, field 1	6.65	44.50	0.149	0.035	0.1160	5.16	20.6
Leaming, field 2	6.08	40.70	0.149	0.035	0.1160	4.72	18.8
Timothy and clover:							
Field 2	....	3.66*	1.340†	....	....	6.09	24.4
Field 3	....	2.71*	1.320†	....	....	4.54	18.2
Field 6	....	3.00*	0.840†	....	....	7.07	28.3

* Tons. † Per ton.

Report of fieldwork at the Central Experiment Station, Berkeley, California, E. KELLNER (*California Sta. Report for 1891–'92, pp. 137–144*).—Brief notes on farm and garden work and tabulated data giving the time of planting and ripening and the extent of injury by rust and by the Hessian fly for 141 varieties of wheat, 39 of oats, 7 of rye, 10 of spelt, and 36 of barley, all grown in 1892. Some varieties of wheat were badly infested with the Hessian fly. Following is a list of varieties on which no flies were found: No. 1 Australian, Australian, Black Bearded, Big Long-Bearded Club, Blue Glass, Big White Club, Bearded (from Missoyen), Champlain, Cujarian, Common March, Centennial Black Bearded, Diamond, Defiance, Extra Early Oakley, Egyptian Imported, Emmer, Egyptian, Early Clawson, Frankensteiner, Forelle, Fultz, F. Gates, Fulcaster Winter, Greek Atlanti, Ghika (or Odessa), Genoese Winter, Harris, Indian (three months), Improved Rice Winter, Mammoth, Michigan Mixed, McGeehe White Winter, Missoyen, Nonpareil, Nonette Lausanne, Nicaragua (from Texas), Oregon Big White Club, Palestine, Probsteier, Polish Proper, Petoli, Pringle Best, Patent Office, Red Club Hedgehog, Red Bearded, Russian Durmur, Raub Black Prolific, Royal Australian, Red Sonora, Red Sea, Snowflake, Solid Straw Poulard, Taganrog, Tunisian, Victor, Victoria, Volo, Winter Fulcaster, White Club, and White Crimea. A few flies were found on some of the varieties of barley, and 4 varieties of spelt were badly infested, while 3 entirely escaped.

The cereals at the San Joaquin Valley Station, C. H. SHINN (*California Sta. Report for 1891–'92, pp. 209–211*).—Tabulated data for 46 varieties of wheat, 5 of rye, and 16 of barley grown without irrigation on alkali land.

Field experiments with corn, A. T. NEALE (*Delaware Sta. Report for 1891, pp. 22–31*).—Experiments to test the value of the Early Mastodon variety, the effect of removing tassels, and the insecticidal qualities of commercial fertilizers. Early Mastodon corn made a satisfactory yield, but required one hundred and twenty days for maturity instead of ninety-six, as claimed for it. A slight gain in yield of grain resulted from removing the tassels from every alternate row. On detasseled stalks the ears were heavier but less numerous. Notes and tabulated data on an experiment with special reference to combating insects by the application of fertilizers are given.

Experiments with the cowpea, A. T. NEALE (*Delaware Sta. Report for 1891, pp. 16–20*).—Notes on experiments conducted on four farms in the State, having in view the determination of the value of the cowpea in farm rotations and the effects of fertilizers on the yield of cowpea vines. Analyses of pea-vine hay are given.

Grasses, clovers, sorghums, and small cultures at the Southern Coast Range Station, R. D. CRUICKSHANK (*California Sta. Report for 1891–'92, pp. 199–202*).—Brief notes on Japanese wheat grass, Hungarian brome grass, Schrader's brome grass, *Festuca elatior*, Australian rye grass, *Paspalum dilitatum*, Italian rye grass, *Holcus lanatus*, *Agropyrum glaucum*, Texas blue grass, millet grass, tall oat grass, timothy grass, red clover, *Trifolium hybridum*, *Trifolium repens*, *Trifolium incarnatum*, alfalfa, sweet clover, sainfoin, *Hedysarium coronarium*, *Medicago lupulina*, *Anthyllis vulneraria*, *Lotus tetragonolobus*, French lentils, jute, dyer's madder, tagasate (*Cytisus proliferus*), pyrethrum plant, Jersey kale, citron melons, field peas, English beans, varieties of wheat and barley for hay, mixed pastures, sorghum, corn, buckwheat, garden peas, and potatoes.

The experience of three years proved Hungarian brome grass the best of all the grasses tried for prolonged verdure during the hot months; Schrader's brome grass and the Japanese wheat grass came next. Sainfoin was very successful, remaining green throughout the dry weather. Jersey kale withstood drought, citron melons yielded abundantly, and English beans and buckwheat were successfully grown. For hay the Sonora was the best variety of wheat, and the Chevalier barley was recommended for the same purpose.

Experiments with grasses and other forage plants, J. CLAYTON (*Alabama College Sta. Bul. No. 49, Oct., 1893, pp. 5–8*).—Spurry on thin sandy land made a growth 8 to 10 inches high. Analysis of the air-dry plant made sixty days from time of planting gave 10.28 per cent of crude protein and 48.19 per cent of nitrogen-free extract.

Rescue grass (*Bromus unioloides*) has annually reseeded itself on the station farm, and the same land has borne a crop of peas each summer. Rescue grass has given two good cuttings, in late winter and early spring. Texas blue grass set in February, 1889, at distance of 18 by 18 inches, required two years to form a perfect sod, and is now growing vigorously. Festuca No. 1, from Connecticut, is a winter grass suitable for lawns, but sun scalds badly during the summer months on sandy soils. Lists of 26 grasses and of 5 leguminous forage plants are given.

Hay growing in the Sierra foothills, G. HANSEN (*California Sta. Report for 1891–'92, pp. 186–189*).—Brief notes on the yield of hay made in 1892 by 18 varieties of wheat, 8 of barley, 3 of rye, and 6 of oats. The average yield of wheat hay was 3,763 pounds, of barley hay 2.493 pounds, of oat hay 3,861 pounds per acre.

Special nitrogen experiments on grass, C. D. WOODS and C. S. PHELPS (*Connecticut Storrs Sta. Report for 1892, pp. 36–46*).—A continuation of an experiment reported in the Annual Reports of the station for 1890 and 1891 (E. S. R., vol. III, p. 376; IV, p. 28). The purpose of the experiment was to ascertain the yield and composition of the hay crop and the financial result from using different amounts of a nitrogenous fertilizer on a meadow consisting of a mixture of timothy, redtop, Kentucky blue grass, and clover. One of the eighth-acre plats was unmanured; one received mixed minerals alone; to the others were applied mixed minerals in constant quantity, and either 25, 50, or 75 pounds of nitrogen per acre in the form of nitrate of soda. The fertilizers were applied April 26, with the exception of one third of the nitrate of soda on the two heavily manured plats, and this was applied May 26. Meteorological data for the season of 1892 are given in E. S. R., vol. V, p. 565.

The yields of hay and of separate food ingredients, the composition of the hay grown with different fertilizers, the amounts of nitrogen removed in the crops and supplied by the fertilizers, and the financial results are tabulated for 1890, 1891, and 1892. The results are summarized as follows:

The addition of mineral fertilizers increased the yield of clover, but did not seem to increase very materially the yield of grasses.

In general the yield of hay increased with the quantity of nitrogen supplied.

The mineral fertilizers, when used alone, were applied at a financial loss.

The application of 160 pounds of nitrate of soda per acre (25 pounds of nitrogen), in addition to the mixed minerals, gave an average profit during the three years of \$1.40 per acre; 320 pounds of nitrate of soda (50 pounds of nitrogen) gave an average profit of \$5.24 per acre, and 480 pounds of nitrate of soda (75 pounds of nitrogen) an average profit of \$2.45 per acre. The returns from 320 pounds were very uniform, the profit being \$5.10, \$5.12, and \$5.49, respectively, for the three years.

The application of nitrogenous fertilizers increased the percentages of protein in the crop and somewhat in proportion to the amount of nitrogen supplied.

The increase in the amount of nitrogen in the crop did not equal the increased amount of nitrogen supplied in the fertilizers, implying that the plants were not able to utilize all the nitrogen supplied.

Effect of nitrogenous fertilizers upon the percentage of protein in grasses and grains, C. D. WOODS (*Connecticut Storrs Sta. Report for 1892, pp. 60–66*).—The results are tabulated and summarized for seventy-three tests showing the effect of fertilizers on the protein content of grains and grasses. The detailed results of these experiments are published in the present and previous reports of the station. The summarized results are as follows:

Protein in crops grown without nitrogen and with different amounts of nitrogen.

Kind of crop.	Number of experiments.	Phosphoric acid and potash (mixed minerals.)	Mixed minerals and 25 pounds nitrogen per acre.	Mixed minerals and 50 pounds nitrogen per acre.	Mixed minerals and 75 pounds nitrogen per acre.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Corn (grain)	22	10.9	11.3	11.4	12.1
Oats (grain)	5	15.1	15.4	15.7	16.3
Corn stover	22	6.2	6.6	6.6	7.6
Oat straw	5	5.3	4.7	5.2	6.0
Mixed grasses	5	*7.6	7.6	8.8	9.8
Orchard grass	2	8.9	10.2	....	12.6
Timothy	2	7.7	8.1	....	10.6
Redtop	3	....	8.3	....	11.7
Seven other pure grasses	7	....	10.2	....	12.1

* Included more clover than other plats.

In each case, except that of oat straw, the percentages of protein were greater when nitrogen was applied in the fertilizers than when it was not. In general the percentages of protein increased with the amount of nitrogen applied, though in most cases the application of the largest amount of nitrogen seemed to have the most marked effect upon the protein of the crop.

In conclusion some practical applications are made, and the advisability is urged of growing crops richer in protein, both for milk and meat production.

Effects of different fertilizers upon the composition of oats and straw, C. D. WOODS (*Connecticut Storrs Sta. Report for 1892, pp. 47–56*).—These investigations are in continuation of similar work reported in the Annual Report of the station for 1890 (E. S. R., vol. III, p. 378).

The oats and straw from variously manured plats in two separate experiments, a special nitrogen experiment and a soil test, including in all 24 plats, were analyzed. In the special nitrogen experiment, mixed minerals (potash and phosphoric acid) were applied alone and in combination with 25, 50, and 75 pounds of nitrogen per acre in the forms of nitrate of soda and dried blood, respectively; and in the soil test nitrate of soda, dissolved boneblack, and muriate of potash were applied singly, two by two, and all three together, and barnyard manure was applied alone.

The results of the analyses are tabulated, together with the computed yield of food ingredients per acre with each fertilizer.

In the special nitrogen experiment the application of nitrate of soda and the largest application of dried blood appeared to increase the

percentage of protein in the grain and slightly in the straw, but showed no uniform effect on the percentage of other ingredients in either the straw or the grain. As a rule the composition where mixed minerals were used alone was not higher than where no fertilizer was applied. On the other hand, the total yield of food ingredients per acre in both grain and straw was almost universally higher, and sometimes very noticeably so, where nitrogenous manures were applied, but not where mixed minerals were used alone.

In the soil test, nitrate of soda, barnyard manure, and muriate of potash appeared to increase the percentage of protein in the grain, and the use of fertilizers in general appeared to increase the percentage of nitrogen-free extract; but further than that no constant effect was traceable. Nitrate of soda, barnyard manure, and dissolved boneblack, as a rule, increased the total yield of protein, nitrogen-free extract, and fiber per acre.

None of the results were very conclusive. In comparison with other analyses of American-grown oats, those grown in these experiments were noticeably higher in protein.

The combined results of these two experiments and the one made in 1890, as regards the relation between the nitrogen applied in the fertilizers and that found in the crop, are given in the following summary:

Relation between the nitrogen applied and protein found in the crop.

Fertilizers.	Oats.			Straw.			Oats and straw.		
	Nitrate of soda group.	Sulphate of ammonia group.	Dried blood group.	Nitrate of soda group.	Sulphate of ammonia group.	Dried blood group.	Nitrate of soda group.	Sulphate of ammonia group.	Dried blood group.
Percentage of protein in crop:	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*			
25 pounds nitrogen, 1890	15.7	13.9	14.5	5.1	5.7	5.6	......	......	......
25 pounds nitrogen, 1892	16.6	....	15.5	4.2	....	3.9	......	......	......
Average	16.2	....	15.0	4.7	....	4.8	......	......	......
50 pounds nitrogen, 1890	16.3	15.1	14.1	5.3	6.8	5.3	......	......	......
50 pounds nitrogen, 1892	16.4	....	15.9	4.6	....	4.4	......	......	......
Average	16.4	....	15.0	5.0	....	4.9	......	......	......
75 pounds nitrogen, 1890	16.8	15.0	14.7	6.0	7.5	5.4	......	......	......
75 pounds nitrogen, 1892	17.2	....	17.1	6.1	....	5.2	......	......	......
Average	17.0	....	15.9	6.1	....	5.3	......	......	......
Amount of protein in whole crop:	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
25 pounds nitrogen, 1890	68	43	53	43	41	40	111	84	93
25 pounds nitrogen, 1892	120	....	97	76	....	67	196	......	164
50 pounds nitrogen, 1890	82	58	57	58	53	44	140	111	101
50 pounds nitrogen, 1892	121	....	104	86	....	93	207	......	197
75 pounds nitrogen, 1890	100	68	79	78	87	67	178	153	146
75 pounds nitrogen, 1892	133	....	115	181	....	110	314	......	225

The nitrogen was in each case applied with a mixture of muriate of potash and dissolved boneblack. The percentage of protein in the crop is calculated to water-free material, and the total amount of protein is calculated to 1 acre.

The above table shows that the percentage of protein in both the oats and the straw in each experiment increased, as a rule, with the increased application of nitrogen in the fertilizer. It will also be observed that, as a rule, the most marked

advance in the percentages of protein was found where the largest applications of nitrogen were made; that is, the percentages of protein increased in a greater ratio than the increase in amount of nitrogen in the fertilizer. The third 25 pounds of nitrogen seemed to affect the percentage of protein more than the second 25 pounds did. * * *

There was an increase in pounds of protein per acre in the plats supplied with nitrogenous fertilizers somewhat in proportion to the amounts applied. This increase was greatest in the plats to which nitrate of soda was applied. These results are in accord with observations made by the station upon the relation of the protein in corn, and in grass, to the nitrogen applied in the fertilizers.

The increase in the amount of nitrogen in the crop did not equal the increase in the amount of nitrogen applied in the fertilizers, implying that the plants were not able to avail themselves of all the nitrogen supplied.

Distribution of seed oats, C. O. FLAGG and J. D. TOWAR (*Rhode Island Sta. Bul. No. 26, Nov., 1893, pp. 139, 140*).—The yield during three years (1891–1893) of ten selected varieties of oats is tabulated and discussed; and the conditions under which seed of these varieties will be distributed to farmers are stated. The average yield during three years was as follows:

Average yield of different varieties of oats during three years.

Variety.	Grain.	Straw.
	Bushels.	*Pounds.*
Early Blossom	66.6	4,679
Russian	69.0	4,898
Vermont	60.8	4,972
Chennaille Black	66.2	5,104
Bavarian	64.2	5,554
Michigan Clipped	60.5	4,386
Rosedale	62.6	5,029
New York State	59.1	4,419
Joanette Black	60.8	4,367
Improved American	64.7	4,689

Potatoes, amount of seed, B. M. DUGGAR (*Alabama Canebrake Sta. Bul. No. 16, July, 1893, pp. 6*).—Pieces weighing 1, 2, and 4 ounces, others having one and two eyes, and "slips," were used for seed. The experiment was repeated on three varieties—Peerless, Burbank, and Beauty of Hebron.

The total yield increased with the size of the piece planted, except that in the case of Beauty of Hebron the largest total yield resulted from planting pieces weighing 2 ounces, and the largest net yield from pieces containing two eyes. With Peerless and Burbank varieties the largest net yields were produced by planting pieces weighing 2 ounces.

Analyses of sugar beets, M. E. JAFFA (*California Sta. Report for 1891–'92, pp. 116–119*).—Analyses of sugar beets grown in seven different localities in California. The percentage of cane sugar in the juice ranged all the way from 6.64 to 16.20 per cent. The majority of the samples contained 11.5 per cent or over of sugar in the juice.

Sugar-beet culture, R. GIRD (*California Sta. Report for 1891-'92, pp. 217-220*).—A statement of the author's methods of cultivating and handling sugar beets on a large scale.

Experiments with wheat at Kansas Station, C. C. GEORGESON, F. C. BURTIS, and D. H. OTIS (*Kansas Sta. Bul. No. 40, Aug., 1893, pp. 51-62*).

Synopsis.—The experiments were in the following lines: (1) Continuous cropping without manure, (2) methods of seeding, (3) seeding at different rates and at different times, (4) weight of seed, (5) early and late plowing, and (6) test of varieties. The average yield of grain during eleven years on plats cropped continuously with wheat has been 27.03 bushels per acre. The results favor listing, seeding October 10 in preference to October 20, the use of other than light seed, and early plowing.

This work was in continuation of that recorded in Bulletin No. 33 of the station (E. S. R., vol. IV, p. 406). The wheat crop of 1893 was injured by winterkilling, and a large number of wheat plats had to be plowed and planted to corn, so that not as many experiments were carried to a conclusion as in previous years.

Wheat grown continuously without manure (pp. 52, 53).—The yields of wheat per acre are tabulated for each year since 1880, excluding two years when the crop was winterkilled. The average yield per acre has been 27.03 bushels. In 1893 the yield was 11.65 bushels.

Wheat, methods of seeding (pp. 53-55).—The methods tested in 1893 were seeding (1) broadcast, (2) with a roller drill, (3) with lister, (4) with shoe drill, and (5) with hoe drill. The yields of grain and straw on each plat, and the average yield per acre for each method in 1893 and during three years, are tabulated. A summary is given in the following table:

Average yield of wheat per acre from different methods of seeding.

Method of seeding.	1893.		Average for three years.	
	Grain.	Straw.	Grain.	Straw.
	Bush.	*Tons.*	*Bush.*	*Tons.*
Broadcast	10.95	0.74	22.47	1.34
Roller drill	9.45	0.87	21.93	1.36
Lister	19.62	0.88	25.33	1.22
Shoe drill	11.58	0.77	23.70	1.37
Hoe drill	14.83	0.73	*23.34	*1.38

*Average for two years.

"The averages this year are of interest in that they show that in a dry season it is best to put the seeds deep in the ground, as with a lister."

Wheat, different quantities of seed sown at different dates (p. 55).—On account of winterkilling this experiment was unsatisfactory. The seeding made October 10 happened to be in time for the rains, came up earlier, and made a better yield.

Wheat, weight of seed (pp. 55, 57).—Tabulated yields of grain and straw on 20 plats seeded with (1) light seed weighing 56 pounds per

bushel, (2) common seed weighing 62½ pounds, (3) heavy seed weighing 63 pounds, and (4) selected seed weighing 61½ pounds, obtained by picking the largest and finest heads in the field just before the crop was cut.

The following table gives the yield in 1893 and for three years from sowing the several classes of seed:

Average yield of wheat per acre from sowing seed of different weight.

Grade of seed.	1893.		Average for 3 years.	
	Grain.	Straw.	Grain.	Straw.
	Bushels.	*Tons.*	*Bushels.*	*Tons.*
Light seed	15.46	0.92	25.19	1.38
Common seed	17.46	0.82	26.57	1.42
Heavy seed	17.43	0.89	27.07	1.57
Select seed (average for two years)	17.23	1.00	25.82	1.74

Wheat, early and late plowing (pp. 57, 58).—A large plat was plowed August 1 and twice disked to keep weeds in check. Another plat was plowed September 7 and immediately disked five times. Both plats were seeded September 12 with Currell wheat. The early-plowed plat was somewhat moist about 3 inches below the surface at the time of seeding, but the late-plowed plat was very dry. The wheat on the former came up quickly, on the latter slowly. The yield from early plowing was at the rate of 14.57 bushels of wheat and 0.7 ton of straw per acre, and from late plowing 11.99 bushels of grain and 0.49 ton of straw.

Wheat, test of varieties (pp. 58–61).—Tabulated data are given for 58 varieties grown at the station in 1893. The large list of varieties grown in former years was reduced by excluding from the experiments of 1893 nearly all of those which had averaged less than 35 bushels per acre during the preceding two years. This left 47 varieties from the old list. Thirty-five varieties from Australia were sown at the same time as the others and under similar conditions, but all the Australian varieties were completely winterkilled.

Experiments with wheat, J. CLAYTON (*Alabama College Sta. Bul. No. 49, Oct., 1893, pp. 3–5*).—Twelve varieties of English wheat and three other varieties were tested on one-hundredth-acre plats in 1893. The following varieties are recommended in the order named for cultivation in the State: Purple Straw, White Chaff, Anglo-Canadian, Large White, Large Red, and Earliest of All.

HORTICULTURE.

Does mulching retard the maturity of fruits? L. H. BAILEY (*New York Cornell Sta. Bul. No. 59, Nov., 1893, pp. 243–254, fig. 1*).—To test the accuracy of the "general opinion that a mulch or heavy cover placed upon the soil about plants when it is frozen will retard

flowering and the maturing of fruit," observations were made during the spring of 1893, when the buds began to start on apples (four years old), almonds, buffalo berries, blackberries, raspberries, currants, gooseberries, grapes, juneberries, peaches, and quinces, heavily mulched in February when the snow was "well settled and a foot or more deep in the open fields," with coarse manure and litter from horse stables; on strawberries mulched in the latter part of March, and on roses which had been mulched the preceding fall for winter protection. It was evident that the mulches kept the temperature of the soil about the plants much lower than that of the surrounding unmulched soil, but this apparently had no effect upon the swelling of the buds which projected above the mulch. The development of buds on twigs covered by the mulch was, however, greatly retarded. In the case of strawberries this was especially marked.

Gen. Putnam and Oregon Everbearing were mulched March 25, when the ground was completely thawed out. The mulch covered the plants and the entire space between the rows to the depth of 3 inches. On May 15 this mulch was removed. At this time the unmulched plants were in full leaf and were nearly ready to bloom. The plants under the mulch were just starting into leaf and the growth was weak and bleached. The plants were endeavoring to push themselves through the cover to the light and air. The mulch was forked off the plants and they gradually assumed a normal color and habit, and bloomed June 1. The bloom was delayed from ten days to two weeks, according to the depth of the covering. The plants did not seem to recover entirely, however, and the fruitage was somewhat lighter than on the normal plants, but it was delayed about a week.

Correspondence giving the experience of various horticulturists in mulching strawberries to retard blooming and fruiting is appended, and the following general conclusions are drawn:

(1) The early bloom of fruit plants depends very largely upon the appropriation of food stored in the twigs, and it is more or less independent of root action. This is proved both by direct experiment and by study of the physiology of plants.

(2) It must follow, then, that the temperature of the twig or branch must be reduced if its vegetation is to be much retarded; or, in other words, the top of the plant, as well as the soil, must be mulched, and in practice this is possible only with strawberries and other very low plants, or those which are laid down during winter.

(3) There is danger of injuring plants by heavy mulch which is allowed to remain late in the spring. If it is desired to retard flowers or fruit by mulching, the practice should not be violent and the plants should be carefully watched.

(4) Many strawberry growers are able to delay the ripening of fruit, by mulching, from two days to two weeks; but a week's delay is usually about the limit of profitable results.

Field experiments with tomatoes and onions, R. L. WATTS (*Tennessee Sta. Bul., vol. VI, No. 4, Oct., 1893, pp. 75–82, plate 1*).—*Tomatoes* (pp. 75–81).—The Acme variety was used in all experiments. Liquid manure did not increase the weight or number of tomatoes. In 1892 plants transplanted at a medium depth yielded more than those set very deep or very shallow. In 1893 medium and shallow setting gave practically the same results, the yield being larger than that from deep setting. In a comparison of different methods of training, the largest

yield was made by training to 3 stems, the next by training to 2 stems, and least by single-stem training. In another experiment, comparing single-stem training with no training, the yield from the former was at rate of 910 bushels per acre; from the untrained area, 340 bushels. The difference in yield is regarded as due to the greater number of trained plants that can be grown on a given area. The trained plants were set at distances of 1 by 3 feet. Among the advantages of single-stem training are mentioned increased earliness, larger and smoother fruit, larger yield, greater ease of picking, and decrease in the injury from rot and from insect enemies. The method of training to a single stem is described and illustrated. Cutting back to two or three inches at transplanting decreased the yield.

As the result of three years' experiments, the following varieties are recommended: Acme, Golden Queen, Yellow Pear, Red Pear, Volunteer, King Humbert, McCullom Hybrid, Early Paragon, Livingston Beauty, Livingston Favorite, Dwarf Champion, Yellow Plum, Ignotum, Turner Hybrid, and Early Michigan.

Onions (pp. 81–82).—Onion seed was sown in hotbeds February 23; the young plants were thinned when 2 inches high and were transferred to the field April 1. Scarcely any plants were lost in transplanting. July 1, when the bulbs measured 1 to 2 inches in diameter, the plants were attacked by a fungus disease, which will be described in a future bulletin, and premature harvesting was necessary.

Of the varieties planted, Prize-taker gave the best results. White Globe, White Victoria, Giant Rocca, and Red Weathersfield proved satisfactory.

Report of the horticulturist of the Delaware Station (*Delaware Sta. Report for 1891, pp. 76–88*).—Notes and tabulated data on 30 varieties of tomatoes, description of a bicolored tomato, test of potatoes, to ascertain best amounts for seed purposes, brief note on varieties of potatoes, and list of strawberries, raspberries, blackberries, grapes, peaches, plums, and quinces planted.

Small fruits, R. L. WATTS (*Tennessee Sta. Bul., vol. VI, No. 3, July, 1893, pp. 61–74, plates 4*).—*Strawberries* (pp. 61–70).—The total shipment of berries from the State in 1892 was estimated at 2,760,000 quarts. Directions regarding the character of soil, method of preparing the soil, setting and cultivating the plants, and choice of varieties are given, together with notes and tabulated data for 31 varieties of strawberries, set March 12, 1892. The first picking of the Crescent, Early Canada, and Sweetzer Early was made April 29. Crescent gave the largest yield. Taking into consideration earliness, productiveness, size, quality of berries, and hardiness, the following gave the best results in the order named: Crescent, Windsor Chief, Haverland, Bubach, and Jesse. Lists of varieties considered by growers in 25 counties as best adapted to their conditions, and brief notes on leaf blight (*Sphærella fragariæ*) are given.

Raspberries (pp. 71–73).—Notes and tabulated data regarding 20 varieties of raspberries. Of 8 red varieties Turner was most productive, afforded the first ripe berries, and continued in bearing longer than any other sort. The first berries were picked May 21, the last forty-two days later. The Marlboro was second only to Turner in earliness. Cuthbert made the most vigorous growth.

The most productive of the 3 yellow fruiting was Golden Queen, it being third in productiveness of the 20 varieties reported. Of the 9 black fruiting varieties Palmer Seedling was most productive, and among the 20 varieties it was excelled in yield by Turner only. Of the black varieties, Palmer Seedling and Doolittle Improved are recommended for general cultivation.

Blackberries (p. 73).—Of 13 varieties planted only 6 fruited in 1893. The best yields were made by the Taylor, Ancient Briton, and Agawam.

Grapes (pp. 73, 74).—Of 126 varieties planted in March, 1891, 13 fruited in 1893. Of these the Worden was the most productive.

Some new fruits, B. M. DUGGAR (*Alabama Canebrake Sta. Bul. No. 17, pp. 11, 12*).—A dwarf Juneberry (*Amelanchier canadensis* var. *oblongifolia*) proved hardy and productive, ripening in May. The Crandall currant, Buffalo berry, apricot plum (*Prunus simonii*), *Alœagnus longipes*, wineberry, Industry gooseberry, and All Summer raspberry were tested, all except the Crandall currant proving satisfactory.

Grapes, B. M. DUGGAR (*Alabama Canebrake Sta. Bul. No. 17, July, 1893, pp. 3–11*).—Notes on 31 varieties and directions for planting, training, and cultivating grapes. For local planting the following varieties are recommended:

Among the black grapes Moore Early, Hartford, Ives, Wilder, Concord, and (for wine) Norton Virginia. Niagara has proved best of the white varieties, though Grein Golden sometimes does well.

Delaware and Perkins are the most reliable of the red varieties. The former should not be sacked, as it wilts badly. Perkins is wholly free from disease, should be sacked, and then gathered before ripe. Lindley and Vergenes are two red varieties of excellent flavor, and, though not wholly reliable, they are superior for table use.

Investigations of California prunes, apricots, and peaches, G. E. COLBY (*California Sta. Report for 1891–'92, pp. 91–98*).—A reprint of Bulletin No. 97 of the station (E. S. R., vol. IV, p. 157).

Horticultural work at the San Joaquin Valley Station, C. H. SHINN (*California Sta. Report for 1891–'92, pp. 204–209*).—General statements regarding the work of the station, and brief notes on apricots, peaches, plums, nectarines, almonds, apples, pears, olives, pomegranates, mulberries, oranges, Kai apple (*Aberia kaffra*), and the camphor tree.

The work of the South California Station, C. H. SHINN (*California Sta. Report for 1891–'92, pp. 212–217*).—Notes on improvements made at the station and on olives, oranges, lemons, cherries, almonds,

plums, prunes, pears, apples, figs, peaches, apricots, walnuts, Japanese persimmons, guavas, grapes, date palms, perennial cotton, sugar cane, and cassava.

Fruits and grapes at the Southern Coast Range Station, C. H. SHINN (*California Sta. Report for 1891–'92, pp. 193–199*).—Brief general notes on apples, pears, cherries, apricots, almonds, peaches, nectarines, plums, prunes, walnuts, olives, oranges, quinces, Japanese persimmons, mulberries, and grapes.

Fruits at the California Foothill Station, C. H. SHINN (*California Sta. Report for 1891–'92, pp. 181–186*).—Brief notes on peaches, apples, pears, plums, prunes, apricots, nectarines, almonds, and cherries, and tabulated data regarding 51 varieties of peaches. The time of flowering for most varieties of peaches was from March 15 to March 19.

The Chinese cling, which ripened August 17, blossomed March 8, the earliest of the 51 varieties. Mrs. Brett, a late peach (September 1), blossomed March 9. On the other hand, most of the early peaches—Alexander, Amsden, and Jennie Worthen, ripening July 6, 7, and 8—were in blossom from ten to thirteen days later. The increased safety from frost secured by varieties that blossom so much later is evident. Among the main crop peaches, Governor Garland, Shumaker, and Wager are nearly as late in blossoming as the earliest varieties.

The fig in California, C. H. SHINN (*California Sta. Report for 1891–'92, pp. 147–157*).—A reprint from Bulletin No. 96 of the station (E. S. R., vol. III, p. 686) with additional notes on the fruit of the different varieties. The Early Violet proved early, hardy, and a good bearer. Its fruit was small, brown, and of excellent quality.

The highest-flavored fig grown at the stations is the Du Roi, a rather small fig, with white flesh and very smooth, thin, and fragrant skin. This fig is so delicious that if it would bear transportion fresh, which I doubt, growers would find it hard to supply the demand. For preserving, canning, or packing "soft-dried" in flat sealed cans, as some growers have put up other varieties, it ought to rank very high, owing to its beauty and quality.

The Hirtu du Japon probably comes next, after the Du Roi, in point of quality, among the new figs. It is a dark-purple fig, with yellowish white flesh and pinkish purple calyx. There are only a few perfect seeds. * * * The keeping quality of the fig is rather unusual, and it never "sours" on the tree or ground. The size is medium; the shape round and full. The tree is compact, handsome, and the greatest bearer in the whole list of varieties tested.

Brown Turkey seems to be the next best bearer at Tulare Station. For family planting this fig ought to rank among the choice. * * *

There are several small black figs of high quality. Pasteliere is one that grows well and bears well. Betada and Jerusalem, two sorts not yet fruited on the coast, are very rich, and deserve planting for family use. Agen, small to medium, round green skin, has flesh as dark as most of the blacks, and is a high-flavored variety, late-ripening, and remaining long on the tree. * * * The older varieties do well; among these are the Black Genoa, the favorite fig of Languedoc and Provence; the Black Ischia, called one of the best varieties for growing in pots; the greenish yellow and brown Brunswick, a rich and excellent fig. * * *

The Doreé Narbus, hardiest of all the figs at the stations, proves to be a small yellow fig of rather inferior quality, though it may improve as the tree ages.

Further analyses of California olives, G. E. COLBY (*California Sta. Report for 1891–'92, pp. 113–116*).—A continuation of the work reported in Bulletin No. 92 and the Annual Report of the station for 1890 (E. S. R., vol. II, p. 629; III, p. 592).

The average results of examinations of 26 samples of olives grown in 1891 and 1892 are tabulated; the data given relate to time of ripening, proportion of pits, flesh, and oil, and the results of the "iodine absorption" test.

California oranges and lemons, G. E. COLBY (*California Sta. Report for 1891–'92, pp. 99–113*).—A continuation of the work reported in Bulletin No. 93 of the station (E. S. R., vol. III, p. 78). The article contains brief descriptive notes on 21 samples of oranges and 11 of lemons of the crop of 1892, and physical, proximate, and ash analyses of same; notes and tabulated data on proportions of rind, juice, and flesh in oranges and lemons; sugar and acid content of orange and lemon juice; and soil exhaustion from growing oranges and lemons.

The average results of analyses of citrus fruits in 1892 were as follows:

Proximate analyses of oranges and lemons grown in 1892.

	Physical analysis.				In juice.					In fresh fruit.	
	Average weight.	Rind.	Pulp, pressed.	Seeds.	Juice.	Solids.	Total sugars.	Cane sugar.	Acid.	Nitrogen.	Albuminoids.
Oranges:	*Grams.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*c. c.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*
Navel	267.9	28.2	30.4	......	89.60	13.40	11.57	5.42	1.02	0.164	1.030
Seedlings	174.5	24.1	28.9	1.60	69.60	14.57	12.63	5.28	1.29	0.168	1.050
King*	133.3	31.9	20.6	1.50	63.20	14.99	13.17	5.67	1.39	......	......
Ruby Blood	118.6	29.1	23.7	0.80	50.00	15.40	13.00	5.30	1.92	0.269	1.682
Tardive (Valencia late)	190.00	22.1	24.5	0.50	86.60	11.40	9.20	4.90	1.12	0.144	9.900
Tangerine	54.5	26.00	31.4	2.40	21.60	13.80	11.03	7.41	0.87	0.155	0.970
Mandarin	58.9	24.6	19.5	1.30	28.50	14.25	13.84	9.67	0.36	......	......
Mediterranean sweet	187.3	30.3	27.9	0.40	70.00	13.88	10.78	5.12	1.67	......	......
Mediterranean sweet or large St. Michael	198.00	30.00	31.5	0.20	79.30	9.80	7.65	4.31	0.92	......	......
St. Michael	171.00	23.8	29.9	0.30	70.00	14.25	12.20	6.52	1.55	......	......
St. Michael	121.00	20.5	28.5	1.40	53.00	10.22	8.04	3.95	0.88	0.178	1.119
Lemons (average for 11 samples)	118.12	31.6	25.2	0.54	44.35	10.93	2.45	......	7.53	0.152	0.950

* Average of 3 samples from crops of 1887 and 1892.

The Navel orange possessed no advantage, with respect to the proportion of skin to flesh, over the Seedlings, Mediterranean Sweet, St. Michael, or Malta Blood. Of the varieties noted in the table the Navel was the dryest, the St. Michael the most juicy. "The King orange * * * seems to promise to equal, if not exceed, the St. Michael in juiciness." The maximum of total sugar in the juice, 14.70 per cent, was afforded by Seedling No. 59, from Englewood; the maximum of cane sugar, 9.67 per cent, was from Mandarin. The Mandarin yielded the least acid, 0.36 per cent, of all the oranges examined. The maximum of albuminoids, 1.682 per cent, was found in the Ruby Blood.

The following table gives the amounts of fertilizing ingredients removed from the soil by oranges and lemons:

Ingredients withdrawn from the soil by citrus fruits.

	Total ash.	Potash.	Phosphoric acid.	Nitrogen.
Oranges.				
European (seedless):	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Crop of 1,000 pounds	6.07	2.78	0.67	2.69
Crop of 20,000 pounds	121.40	55.60	13.40	53.80
California:				
Crop of 1,000 pounds	4.32	2.11	0.53	1.83
Crop of 20,000 pounds	86.40	42.20	10.60	36.60
Florida:*				
Crop of 1,000 pounds	9.16	4.76	0.79	1.24
Crop of 20,000 pounds	183.20	95.20	15.80	24.80
Lemons.				
California:				
Crop of 1,000 pounds	5.57	2.69	0.61	1.51
Crop of 20,000 pounds	111.40	53.80	12.20	30.20

* Florida Station Bulletin No. 17 (E. S. R., vol. IV, p. 346).

From the table it appears that potash, in which California soils are rich, is the ingredient removed in largest quantity. Phosphoric acid and nitrogen, though less heavily drawn upon, should be supplied in the fertilizer for the orange orchard.

"The average Eureka lemon, as we find it, contains 31 per cent of rind, as against 23 per cent for the average Lisbon. * * * The high acid content, and the relatively large percentages of sugar shown by the analyses, sufficiently recommend California-grown lemons to a high position in all markets."

The African date palm, C. H. SHINN (*California Sta. Report for 1891–'92, pp. 144–147*).—A reprint from Bulletin No. 96 of the station, giving brief notes on palms imported from Algeria and Egypt and formerly inadvertently referred to as Persian palms (E. S. R., vol. III, p. 686).

Sulphuring in fruit drying, E. W. HILGARD (*California Sta. Report for 1891–'92, pp. 127, 128*).—A reprint from Bulletin No. 96 of the station (E. S. R., vol. III, p. 685).

FORESTRY.

Native shrubs of California, E. L. GREENE (*California Sta. Report for 1891–'92, pp. 157–166*).—Brief descriptive notes on *Osmaronia cerasiformis, Rubus vitifolius, Cercocarpus betuloides, C. parvifolius, Fremontia californica, Garrya elliptica, Ribes tenuiflorum, R. aureum, Lavatera assurgentiflora, L. venosa, L. insularis, L. occidentalis, Prunus subcordata, and Amygdalus andersonii.*

Tree planting on Mount Hamilton, C. H. SHINN (*California Sta. Report for 1891–'92, pp. 168–172*).—Brief statements regarding previous plantings and climate of Mount Hamilton and recommendations on a system of tree planting and management.

SEEDS—WEEDS.

Walter H. Evans, *Editor.*

Distribution of seeds and plants, E. J. Wickson (*California Sta. Report for 1891–'92, pp. 172–180*).—A reprint of Bulletin No. 95 of the station (E. S. R., vol. III, p. 444), with acknowledgments of donations received during the years 1891 and 1892.

The Russian thistle, E. S. Goff (*Wisconsin Sta. Bul. No. 37, Oct., 1893, pp. 15, plates 3*).—The bulletin consists principally of a reprint of Farmers' Bulletin No. 10 of the U. S. Department of Agriculture (E. S. R., vol. IV, p. 669).

DISEASES OF PLANTS.

Walter H. Evans, *Editor.*

Effect of certain fertilizers in promoting the development of potato scab and possible reasons for the same, H. J. Wheeler and J. D. Towar (*Rhode Island Sta. Bul. No. 26, Nov., 1893, pp. 141–156*).

Synopsis.—A report upon the effect of lime, ashes, and stable manure in increasing potato scab.

The authors briefly refer to the previous investigations conducted upon potato scab and some of the theories regarding its cause. In 1893 the authors conducted experiments upon 4 plats known to be of uniform fertility. The soil was a sandy loam and exceedingly acid. Essentially the same fertilizers were added to each plat, and in addition 2 plats received air-slaked lime at the rate of 5,400 pounds per acre. The lime and fertilizers were thoroughly harrowed in. The potatoes were planted without any attention or treatment for scab. They were all cut in one lot and planted at the same time. At harvest the plats which had received the lime yielded the greatest amount of merchantable tubers, but the per cent of scabby ones was 48.5 and 47.7 for each plat, as against 3.3 and 15.7, respectively, for the plats receiving no lime. From this experiment it appears that the lime increased the development of the scab. The testimony of numerous observers is added, showing that the presence of lime, wood ashes, or barnyard manure in some way promoted the development of scab in every case. Beets grown upon the same plats as the potatoes gave no indications of scab.

Bolley and Thaxter affirm that the fungus believed to be the cause of the disease grows best in neutral or very slightly alkaline media, and upon this the authors base their reasons for the increased production of the fungus where lime, wood ashes, or stable manure has been used. In a summary of conclusions on potato scab it is stated that—

On soils which are acid, if lime and ashes are employed in such a quantity as to make the soil practically neutral or but slightly acid, there is probably danger of

increasing the scab, provided the soil, seed tubers, or manures are contaminated with the germs of the disease. If the soil and manure are free from the germs, and the tubers can first be effectually treated, then liming can probably be resorted to without hesitation. An acid condition of the soil is unfavorable to the growth of the potato and probably to the fungus which produces the scab.

The bulletin closes with directions for treating seed potatoes with corrosive sublimate as a preventive for potato scab.

Report of mycologist, F. D. CHESTER (*Delaware Sta. Report for 1891, pp. 40–74, figs. 13*).

Synopsis.—Treatment of grape diseases; leaf blight of the pear; peach blight or rot; diseases of the potato; diseases of the tomato; a disease of celery; and notes on fungicides.

Diseases of the grape (pp. 40–44).—A reprint from Bulletin No. 15 of the station (E. S. R., vol. IV, p. 167).

Leaf blight of pear (pp. 44–47).—A reprint from Bulletin No. 15 of the station (E. S. R., vol. IV, p. 168).

Peach blight or rot (pp. 47–53).—Illustrated notes are given on the life history of *Monilia fructigena*. Reprinted notes are given from Bulletin No. 15 of the station (E. S. R., vol. IV, p. 169) upon spraying for the repression of this fungus.

Diseases of the potato (pp. 53–60).—The author mentions three diseases of the potato, viz, blight, or rot, a bacterial disease, and *Macrosporium solani*, with suggestions for their treatment. The disease variously called blight, or rot, depending upon whether the stems and leaves or tubers are attacked, is popularly described, and Bordeaux mixture suggested for its repression. Notes are given on a bacterial disease which is manifest by a wilting of the tops and a soft and offensive rotting of the tubers, unassociated with *Phytophthora infestans* or other filamentous fungus. Reference is made to similar diseases in Europe, and if the opportunity is offered an effort will be made to continue the study of this disease.

The *Macrosporium* causing leaf blight was very common. The fungus is described and figured. The use of Bordeaux mixture is advised as a means for its repression.

Diseases of tomatoes (pp. 60–63).—The diseases described are anthracnose, leaf blight, and tomato rot. The anthracnose is described as caused by *Colletotrichum lycopersici* n. sp. The fungus is figured, and the following technical description of it is given:

Spots depressed, circular, slightly discolored, center black; 5–10 mm. in diameter, afterwards becoming irregular and confluent. Acervuli abundant, densely gregarious rusty brown to black, applanate 95–150 μ in diameter. Setæ abundant, fuliginous, generally curved, rarely undulate or straight, often geniculate, in places gradually tapering, septate, length 65–112 μ. Spores oblong, 16–22 μ x 4 μ; average 18–20 μ x 4 μ. Ends subacute, hyaline, generally containing 2 or 3 oil drops which stain brown with osmic acid. Basidia short, slender, 30-40 μ arising from a well-developed stroma.

On fruit of cultivated tomato.

The disease shows itself upon the tomato as sunken discolored spots, each with a dark center becoming black. These spots increase in size or by a confluence cover a large portion of the decaying fruit. Over this area the fruit is black and shrunken, flattened or depressed, surrounded by a shrunken, corrugated, discolored skin. The disease is easily and quickly produced by introducing the spores within a puncture made by a sterilized needle, but no results have come from repeated attempts to produce the disease by sowing the spores upon the uninjured surface of either ripe or green tomatoes.

The leaf blight and tomato rot are due to the same causes as the same diseases of the potato, and a similar treatment should be given them.

A celery disease (pp. 63-65).—Illustrated and descriptive notes on the diseases caused by *Septoria petroselini apii*, previously mentioned in Bulletin Q of the New Jersey stations (E. S. R., vol. III, p. 885).

Notes on fungicides (pp. 65-74).—Formulas for preparation and chemical reactions are given for the following fungicides: Bordeaux mixture, carbonate of copper in suspension, precipitated carbonate of copper, copper soda mixture, eau celeste, modified eau celeste, ammoniacal solution of copper carbonate, copper and ammonium carbonate mixture, Johnson's mixture, and copper soda hyposulphite.

Fruit tree blight in general, J. M. STEDMAN (*Alabama College Sta. Bul. No. 50, Nov., 1893, p. 11*).—A popular bulletin on the subject of fruit tree blight due to bacteria, giving a description of its effect upon the tree, its nature and cause, and recommending pruning and burning as the only effectual remedy for its repression.

Studies in the life history of Puccinia œnotheræ, W. C. BLASDALE (*California Sta. Report for 1891-'92, pp. 227-232, figs. 5*).—The author mentions the occurrence of this rust on the leaves of *Œnothera ovata*. Its various phases are described in detail. Illustrations and notes are given on the life history of the fungus, together with details of all manipulations.

A synopsis of the diseases of cultivated plants, C. W. WOODWORTH (*California Sta. Report for 1891-'92, pp. 258-270*).—The author gives in popular terms a synopsis, or key, for determining the causes and learning the methods of treatment of injuries produced by insects and fungi.

ENTOMOLOGY.

Report of the entomologist, M. H. BECKWITH (*Delaware Sta. Report for 1891, pp. 89-103, figs. 5*).

Synopsis.—General notes; description of injurious insects and remedies; combating the canker worm; arsenites for the curculio and codling moth; pyrethro-kerosene emulsion; hot water as an insecticide; effect of carbon bisulphide on sorghum seed; notes on a corn crambid.

General notes (p. 89).—Insect attacks were not very severe during the past season. The corn worm (*Heliothis armiger*) destroyed some late sweet corn. The black peach aphis did but little injury to nursery stock during the past season. Good results were reported from the use

of tobacco stems about the roots of infested trees. The Colorado potato beetle was not very abundant and the prompt use of arsenites prevented any threatened loss. The rose chafer, or rose bug, was less abundant than in previous years and did little injury.

Descriptions and remedies for injurious insects (pp. 89–93).—Descriptions, brief accounts of their life histories, and suggested remedies for their repression are given for the following: Pear leaf blister (*Phytoptus pyri*), strawberry sawfly (*Harpiphorus maculatus*), grape sawfly (*Selandria vitis*), blackberry leaf miner, cabbage pionea (*Pionea rimosalis*), and pale-colored flea beetle (*Systena tæniata*).

Experiments in combating the canker worm (pp. 93–95).—A report upon the successful use of London purple for the canker worm.

Arsenites for curculio and codling moth (pp. 96, 97).—Brief notes are given on the successful use of Paris green for curculio and of Paris green and London purple for codling moth.

Pyrethro-kerosene emulsion (pp. 97, 98).—A formula and directions for preparations are given, together with notes upon the successful use of the emulsion for rose aphis, cherry aphis, and cabbage worms. The effect upon rose bugs was negative, a satisfactory trial not having been made.

Hot water as an insecticide (pp. 98–100).—The effect of water heated to various temperatures upon blackberry, raspberry, strawberry, grape, currant, pear, tomato, and cabbage is given. The author concludes as follows:

> We find from these experiments that water at 130° F. readily kills aphides and caterpillars.
>
> Cabbage stands a temperature of 160° F. when poured from a sprinkler, and was not seriously damaged by 200° F. The outer leaves were somewhat cooked, but the head was uninjured.
>
> Tomatoes were not harmed by water at 148° F., while the blackberry, raspberry, strawberry, currant, and grape would not stand a temperature much above 130° F.
>
> The greater expense and inconvenience of the application of hot water as an insecticide, when compared with the use of kerosene emulsion or arsenites, are such as to render it of doubtful utility for that purpose. Further experiments, of course, may change our opinion in regard to its use.

The effect of carbon bisulphide upon the vitality of sorghum seed (pp. 100, 101).—Sorghum seed was treated with carbon bisulphide to test its effect upon the vitality of the seed. No injury was observed, there being apparently an increase in favor of the treated seed.

Notes on a corn crambid (pp. 101–103).—A reprint from Bulletin No. 14 of the station (E. S. R., vol. IV, p. 660).

Experiments upon the effect of hydrocyanic acid gas on different insects, R. SCHMIDT (*California Sta. Report for 1891–'92, pp. 233–237, fig. 1*).—The author experimented with quite a number of insects to ascertain the effect of hydrocyanic acid gas on them. Tabular information is given as to the effect the gas had upon the insects, the time of exposure, etc. It was found that some of the *Coleoptera* were alive

after being in the gas for sixty-eight minutes. There were fifty-four experiments conducted upon twenty-four species of insects, representing a considerable range of families.

A synopsis of the orders and families of insects, C. W. WOODWORTH (*California Sta., Report for 1891–'92, pp. 271–312, fig. 3*).—A key in as popular language as possible for the identification of insects. A glossary of scientific terms is added.

The life history of the woolly aphis, K. R. HOWELL (*California Sta. Report for 1891–'92, pp. 223–226*).—The author gives a review of the literature on the life history of the woolly aphis (*Schizoneura lanigera*), together with a list of works cited.

The bollworm, corn worm, or tomato fruit worm, C. E. CHAMBLISS (*Tennessee Sta. Bul. vol. VI, No. 4, Oct., 1893, pp. 83–85*).—The author gives popular descriptions of the various phases in the life of this insect (*Heliothis armigera*), together with notes on its life history, suggested remedies, and a list of some of its natural enemies.

Analyses of Paris green, R. H. LOUGHRIDGE (*California Sta. Report for 1891–'92, p. 79*).—Analyses of 5 samples sent to the station for examination are tabulated.

FOODS—ANIMAL PRODUCTION.

E. W. ALLEN, *Editor.*

Economy of food, W. O. ATWATER (*Connecticut Storrs Sta. Report for 1892, pp. 163–190*).—This article consists largely of material previously printed in the Annual Report for 1891 (E. S. R., vol. II, p. 59) and Bulletin No. 7 of the station (E. S. R., vol. III, p. 213). The author points out, as on former occasions, that a surprisingly large proportion of the food purchased is wasted, and that, as a rule, poor families spend far more for their food than their incomes justify or than is necessary. He shows that more than half of the wages of the working man of this country is spent for food, and that equally nutritious food can be had for far less than is usually paid in the families of the poor. The maxim that the "best is the cheapest" does not apply to food, he says.

A revised and considerably lengthened schedule is given of the amounts of nutrients furnished in 25 cents worth of a large number of common food stuffs, and a table of estimates of digestible and indigestible nutrients in food materials. This table is summarized as follows:

(1) The protein of our ordinary meats, fish, and milk is very readily and completely digested. The protein of vegetable foods is much less completely digested than that of animal foods. Of that of potatoes and beans, for instance, a third or more may escape digestion, and thus be useless for nourishment.

(2) Much of the fats of animal food may at times fail of digestion. This is presumably true of vegetable fats, but the quantities are in general so small that the determinations of the proportions digested are not very accurate.

(3) The carbohydrates, which make up a large part of vegetable food, are in general very digestible. The crude fiber, or cellulose, is an exception, but the quantities

of this in the materials used for the food of man are too small to be of importance. Sugar is believed to be completely digested. This is assumed to be the case with sugar of milk. The other carbohydrates of animal foods are very small in amount.

(4) The animal foods have in general the advantage of the vegetable foods in digestibility, in that they contain more protein and that their protein is more digestible.

(5) The quantity digested appears to be less affected by flavor, flavoring materials, and food adjuncts and to differ less with different persons than is commonly supposed.

A study of actual dietaries, C. D. WOODS (*Connecticut Storrs Sta. Report for 1892, pp. 135–162*).—The results are given of studies of the dietaries of six families, including those of a jeweler, blacksmith, machinist, mason, and two carpenters. The summarized results, together with those for two dietaries published in the Annual Report of the station for 1891, are given in the following table:

Summary of results of dietary studies—food per man per day.

Dietaries.	Nutrients.			Potential energy.
	Protein.	Fat.	Carbohydrates.	
1. BOARDING HOUSE.†				
Food:	*Grams.**	*Grams.*	*Grams.*	*Calories.*
Purchased	126	188	426	4,010
Waste	23	36	25	520
Eaten	103	152	401	3,490
2. CHEMIST'S FAMILY.†				
Food purchased ‡	118	103	430	3,210
3. JEWELER'S FAMILY.				
Food:				
Purchased	91	126	483	3,530
Waste	8	9	5	140
Eaten	83	117	478	3,390
4. BLACKSMITH'S FAMILY.				
Food:				
Purchased	103	176	408	3,730
Waste	3	5	7	90
Eaten	100	171	401	3,640
5. MACHINIST'S FAMILY.				
Food:				
Purchased	100	159	427	3,640
Waste	1	3	6	60
Eaten	99	156	421	3,580
6. MASON'S FAMILY.				
Food:				
Purchased	107	153	391	3,470
Waste	3	5	16	120
Eaten	104	148	375	3,350
7. CARPENTER'S FAMILY.				
Food:				
Purchased	125	152	498	3,970
Waste	11	17	23	300
Eaten	114	135	475	3,670
8. CARPENRER'S FAMILY.				
Food:				
Purchased	107	161	408	3,610
Waste	7	12	20	220
Eaten	100	149	388	3,390
Food eaten:				
Minimum of above	83	103	375	3,210
Maximum of above	118	171	478	3,640
Average of above	103	141	421	3,460
Dietary standards for men at moderate work:				
Voit (German)	118	56	500	2,060
Atwater (American)	125	125	450	3,560

*100 grams = 3.5 ounces, or 0.22 pound. 1 ounce = 28.35 grams. 1 pound = 453.6 grams.
† Report of this station, 1891, pp. 90–106.
‡ There was very little "waste" in this dietary.

Results of analyses of fodders and feeding stuffs, C. D. WOODS (*Connecticut Storrs Sta. Report for 1892, pp. 23–35*).—Analyses with reference to food ingredients are given of the following feeding stuffs: Green orchard grass, timothy, Hungarian grass, wheat fodder, red clover, crimson clover, cowpea, oat and pea fodder, oat and vetch fodder, and barley and pea fodder; hay from mixed grasses, orchard grass, timothy, timothy and redtop, redtop, fowl meadow grass, meadow grass, meadow fescue, blue grass, oat grass, brome grass, Hungarian grass, oats and vetch, and rowen; mangle-wurzels, corn silage, corn stover, oat straw, corn, oats, corn meal, wheat bran, buckwheat, middlings, and new-process linseed meal.

Investigations of cattle food in California (*California Sta. Report for 1891–'92, pp. 119–127*).—A reprint of Bulletin No. 100 of the station (E. S. R., vol. IV, p. 732).

Influence of quantity of food upon economy of milk and butter production, H. J. WATERS, W. H. CALDWELL, and R. J. WELD, (*Pennsylvania Sta. Bul. No. 24, July, 1893, pp. 15*).—The object of this experiment was to compare the effect on the cost of butter production of feeding different amounts of a ration. Ten cows, supposed to comprise 5 of the best and 5 of the poorest butter producers in the station herd, were used. These were Guernseys, Shorthorns, Jerseys, and Ayrshires, mostly grades. The food consisted of cut timothy hay and a mixture of 54.5 parts of corn meal, 27.3 parts of wheat bran, and 18.2 parts of linseed meal. The experiment covered five periods of twenty-four, twenty-one, thirty-two, fourteen, and ten days, respectively. The average amount of food given per cow daily in each period was as follows:

Period 1, 10.7 pounds grain and 14.5 pounds hay; cost, 19.9 cents.
Period 2, 13 pounds grain and 15.9 pounds hay; cost, 22.4 cents.
Period 3, 15.1 pounds grain and 15.1 pounds hay; cost, 25.1 cents.
Period 4, 12.2 pounds grain and 14.9 pounds hay; cost, 20.1 cents.
Period 5, 8.5 pounds grain and 12.8 pounds hay; cost, 17.1 cents.

The cost of food was based on corn meal at $20, wheat bran at $16, linseed meal at $26, and timothy hay at $12 per ton, and no allowance was made for the value of the manure.

Composite samples of milk of each cow were tested by means of the Babcock test twice each week. From the amount of fat found, the yield of butter was calculated by adding one fifth. This calculated butter was valued at 35 cents per pound.

The results show very wide variations between different cows on the same quantity of food. Two of the animals went dry before the conclusion of the experiment, so that the result in period 4 is for 9 cows, and in period 5 for 8 cows. The average results for all the cows in each period were as follows:

Average amounts of food eaten, and financial results per cow.

Period.	Food per day.	Digestible nutrients in food.			Financial results per day.		
		Protein.	Carbohydrates.	Fat.	Cost of food.	Value of butter.	Net profit.
		Pounds.	*Pounds.*	*Pounds.*	*Cents.*	*Cents.*	*Cents.*
1	10.5 pounds grain and 14.6 poounds hay.	1.80	11.93	0.60	19.9	29.6	9.7
2	13 pounds grain and 15.9 pounds hay	2.15	13.84	0.73	22.4	33.2	10.8
3	15.1 pounds grain and 15.1 pounds hay	2.40	14.59	0.81	25.1	31.0	5.9
4	12.2 pounds grain and 14.9 pounds hay	2.01	12.96	0.68	20.1	29.6	9.5
5	8.58 pounds grain and 12.8 pounds hay	1.49	10.13	0.48	17.1	20.4	3.3

Averaging the results for periods 1 and 5 and periods 2 and 4, and comparing these with the average results in period 3, gives the following average results per cow and per day:

Average results of feeding different amounts of food to dairy cows.

	Cost of food per day.	Value of butter per day.	Net profit per day.
	Cents.	*Cents.*	*Cents.*
Average of periods 1 and 5	18.8	26.5	7.7
Average of periods 2 and 4	21.7	31.0	9.3
Period 3	25.1	31.0	5.9

"A study of the above tables clearly shows that for the animals involved the amounts of food given in periods 1 and 5 were too small for the greatest profit and in period 3 the amount was excessive so far as the financial returns are concerned, while in periods 2 and 4 the point of most profitable production was reached. * * *

"The ration giving us the greatest net profit, viz, that used in period 2, contains less organic matter and protein and slightly more carbohydrates and total digestible nutrients than was found to be the average of the rations fed by a number of the leading dairymen of Wisconsin and than is prescribed in Wolff's standard, but agrees quite clearly in all details with the American standard proposed by Prof. Henry."

The amount of butter produced per year as a method of determining the value of a cow, H. J. WATERS, W. H. CALDWELL, and R. J. WELD (*Pennsylvania Sta. Bul. No. 24, July, 1893, pp. 15–17*).—Examples are cited from the record of individual cows in the station herd which indicate that in judging of the merits of a cow the amount of butter fat produced should be considered in connection with the amount of food consumed. For instance, during the year Marguerite produced 296 pounds of butter and Ramona 279 pounds; but the net profit from Marguerite was only $31.50, while that from Ramona was $61.50.

Unquestionably the presumption is in favor of the animal producing the largest quantity of butter per year. On the average this is true, but the most successful dairyman has to deal with individuals rather than averages, otherwise it will be

impossible for him to derive the greatest possible profit from his business. * * * To the careful, thoughtful dairyman there is undoubtedly an opportunity for a great saving by applying the feed test to each animal, as well as the butter test, and weeding out those animals that do not make satisfactory return for the food consumed.

The influence of changes of food and temperature on the quantity and quality of the milk of dairy cows, C. L. INGERSOLL and H. B. DUNCANSON (*Nebraska Sta. Bul. No. 30, Oct. 1, 1893, pp. 44–65*).—As showing the variations in different cows, the results are given of individual tests made of 37 cows during a period of about thirty days. The cows were mostly on farms in the vicinity of the station. The milk was tested daily by the Babcock test, and on two days the results were compared with those obtained by chemical analysis of the samples. The average yield of butter fat per day ranged from 0.13 pound for a Shorthorn cow eight months in milk to 1.572 pounds for a Holstein five months in milk. As between the Babcock test and gravimetric analysis "the agreement was almost perfect."

The results are also given for 8 Shorthorn cows of the station herd for four and one half months. During two and one half months of this time the cows were fed rations increasing in richness, cotton-seed meal being added the last part of the time. The meteorological conditions prevailing during the trial are tabulated, and the effects observed of changes in the weather on the yield of milk and fat.

As to the effect of the changes of food "the final result showed that there was little change produced in the total fat day by day, but that the changes in per cent of fat were fully compensated in changes in the milk yield of the cows."

During the trial ten sudden storms and cold waves occurred.

"Of these, 7 caused a diminished yield of milk, and in 3 the yield was constant. The per cent of fat diminished in 5 observations, remained constant in 4, and increased in 1 observation. In each case the cows were warmly stabled."

The bulletin concludes with a partial list of station bulletins relating to dairying.

Does it pay to shelter milch cows in winter? C. S. PLUMB (*Indiana Sta. Bul. No. 47, Nov., 1893, pp. 89–96, figs. 2*).

Synopsis.—Three native cows kept out of doors during the daytime in winter ate more food, produced less milk, and gained considerably less in live weight than three similar cows fed in the barn. The financial result for the forty-eight days was $12.79 in favor of the sheltered animals.

To demonstrate the ill effects of keeping cows out of doors in winter time, 6 common grade animals were divided into two lots, lot 1 being kept in a comfortable stable all the time, and lot 2 being turned outdoors during the daytime, no matter what the weather. The trial lasted from January 22 to March 10 (forty-eight days). Both lots were fed the same kind of food (clover hay, corn meal, and bran), the amount being regulated by the appetites of the animals. Lot 2 (unsheltered)

ate less hay but considerably more grain than lot 1, the total amount of food eaten being 4,430.7 pounds for lot 1, and 4,647.5 pounds for lot 2. With clover hay at $8 per ton and corn meal at $1 and bran at 65 cents per 100 pounds, the food for lot 2 cost $4.23 more than that for lot 1.

Lot 1 gave 3,041.2 pounds of milk and lot 2, 2,880.1 pounds, a difference of 161.1 pounds in favor of the sheltered animals. The writer believes that the difference in milk yield was largely influenced by the conditions of shelter. At 15 cents a gallon this extra yield of milk would be worth $2.79. The sheltered lot gained 231 pounds during the experiment and the unsheltered lot lost 33 pounds. This 231 pounds of gain at 2½ cents a pound would be worth $5.77. This gives a total of $12.79 in favor of the sheltered animals for the forty-eight days, or $4.26 per animal.

Feeding experiments with milch cows on soiling crops, C. S. PHELPS (*Connecticut Storrs Sta. Report for 1892, pp. 127–134*).—A reprint from Bulletin No. 9 of the station (E. S. R., vol. IV, p. 480).

Experiments in feeding steers, C. C. GEORGESON, F. C. BURTIS, and D. H. OTIS (*Kansas Sta. Bul. No. 39, Aug., 1893, pp. 15–50, plates 6*).

Synopsis.—A comparison of feeding 19 three-year-old range steers on various rations in the barn and out of doors, from December 20 to April 28. The largest gain was made by a lot on corn meal, shorts, bran, linseed meal, and hay, and this lot brought the highest price per pound. Two lots fed on corn meal, molasses, and corn stover, and on linseed cake and hay, respectively, were fed at a financial loss. A lot fed ear corn and stover out of doors gained as much and gave fully as large a net profit as a lot fed on the same food in the barn.

This experiment is similar to one made the previous year and reported in Bulletin No. 34 of the station (E. S. R., vol. IV, p. 475). For the present experiment 19 steers, about three years old and averaging 1,038 pounds per head, were purchased at the Kansas City stock yards at $3.45 per 100 pounds live weight. The average cost per head delivered at the station was $37.36.

The steers were divided into five lots, lots 1, 2, and 3 including 3 steers each, and lots 4 and 5 including 5 steers each. A preliminary period of three weeks preceded the experiment, which commenced December 20 and continued until April 28. The food of each lot during the experiment proper was as follows:

Lot 1, corn meal, shorts, bran, linseed meal, and hay.
Lot 2, corn meal, molasses, and corn stover.
Lot 3, linseed cake and orchard grass hay.
Lot 4, ear corn and corn stover.
Lot 5, ear corn and corn stover.

All except lot 5 were kept in the barn. Lot 5 was kept out of doors all the time, the only protection afforded being a shed closed on three sides. Food was given in every case *ad libitum*.

At the conclusion of the experiment the steers were sold to Swift & Co. and shipped to Kansas City, where they were slaughtered.

The results for each steer and the summarized results for each lot are tabulated, together with data secured at time of slaughtering; and plates are given showing photographic reproductions of sections of the carcass of different lots.

A summary of the average results for each lot is given in the following table:

Average results of steer-feeding for 129 days.

	Gain per head.	Cost of food per head.	Cost of food per pound of gain.	Amount received per pound live weight when sold.	Financial gain (+) or loss (—).	Weight of fat per head.
	Pounds.		*Cents.*	*Cents.*		*Pounds.*
Lot 1, corn meal, shorts, bran, linseed meal, and hay	309	$21.82	7.06	5.30	+$31.13	96.6
Lot 2, corn meal, molasses, and corn stover	187	24.68	13.20	4.75	—12.85	60.6
Lot 3, linseed cake and orchard-grass hay	223.6	26.11	11.60	4.90	—10.91	48.3
Lot 4, ear corn and stover, in barn	273.8	14.30	5.22	5.10	+62.08	66.1
Lot 5, ear corn and stover, out of doors	275.6	16.65	6.03	5.15	+64.28	84.5

The cost of food is based on ear corn at 47 cents, corn meal at 55 cents, shorts and bran at 54 cents, hay at 25 cents, corn stover at 12½ cents, oil meal at $1.37, and molasses at $1.32 per 100 pounds. It will be seen from the table that lot 1, on corn meal, shorts, bran, linseed meal, and hay, or a "balanced ration," as it is called, made the largest average gain and brought the highest price per pound when sold. As between lots 4 and 5, on ear corn and stover, there is little difference, although lot 5 (fed out of doors) gave a profit of $2.20 more than lot 4 (fed in the barn). "The question would stand a little differently if the indoor steers had been accustomed to confinement. * * * It should be noted in this connection that, on the whole, last winter was favorable to outdoor feeding; and further, that the shed provided for lot 5 afforded perhaps more shelter than farmers usually give their steers."

The carcasses of lot 5 had more fat than those of any other lot except lot 1. Lot 3 had the least fat of all, which "bears out the theory that a highly nitrogenous feed is not a fat-producer." The result with lot 2 "proves decidedly that molasses is neither a good feed nor in the line of economy."

Following is the authors' summary of the results of the experiment:

(1) The steers feed on the balanced ration [lot 1] gained more rapidly than any of the others; they were in better market condition and brought a higher price than any of the others, and they consumed less food per pound of gain than the others, all of which confirms the results of last year. But these factors do not necessarily imply the most profit, as the account proves.

(2) A mixture of molasses and corn meal proved to be a very inferior fattening material.

(3) The exclusive diet of oil cake did not yield as good results as either the balanced ration or corn. The animal organism appears to be unable to make use of so highly concentrated nitrogenous feed to good advantage.

(4) Ear corn fed in the barn did not produce as good gains as did the balanced ration fed under the same conditions, but, being a cheaper feed, it proved to be slightly more profitable.

(5) The steers fed ear corn out of doors gained at practically the same rate during the experiment as those fed ear corn indoors, but they ate 2 pounds corn and 1.5 pounds fodder more per pound of gain than did the indoor steers. This confirms the results of last year.

(6) Steers which are tied up in the barn, if not accustomed to this method of handling will fret under the restraint for several weeks, during which time the gain is but slight for the feed eaten. From this we conclude that good shelter is favorable to economical feeding, but it should not put the steers under restraints to which they are unaccustomed.

Steer feeding; a well balanced vs. a poorly balanced ration, R. H. MILLER (*Maryland Sta. Bul. No. 22, Sept., 1893, pp. 61–66*).

Synopsis.—A comparison of a nitrogenous with a carbonaceous ration on two lots of 4 steers each. In three months the steers on the nitrogenous ration made the largest and the cheapest gains, and also brought the highest price per pound.

Eight grade Shorthorn steers brought from the West were divided into two equal lots and, after a preliminary period of twenty-five days to accustom them to confinement, were used for the experiment. The steers averaged about 987 pounds each in live weight, and the weight of the two lots was very nearly the same. For three months, January 10 to April 11, both lots were fed cut corn fodder, turnips, a little molasses, and grain. The grain for lot 1 was a mixture of 15 parts of corn-and-cob meal, 4 parts of cotton-seed meal, and 2 parts of wheat bran; and that for lot 2 was corn-and-cob meal alone. The proportion of corn fodder to grain was about 4 to 6 for lot 1 and 4 to 5 for lot 2. In this proportion the steers were given all they would eat. During the trial lot 1 made an average gain of 250 pounds per head and lot 2 153 pounds per head. The gain was nearly uniform for the steers in lot 1, but very irregular for those in lot 2, varying from 54 to 200 pounds with different animals. Leaving out No. 6, which gained only 54 pounds, the average gain for the other three was 186 pounds.

The total cost of the food with corn fodder at \$2.50, corn-and-cob meal at \$15, cotton-seed meal at \$29.50, wheat bran at \$18.50, and turnips at \$3 per ton, was \$69.14 for lot 1 and \$42.57 for lot 2, or 6.9 and 7 cents per pound of gain, respectively. No allowance was made for the value of the manure, except as an offset for the cost of labor.

At the conclusion of the trial the steers were sold, the price ranging from \$4.62½ to \$5.37 per 100 pounds live weight, and being uniformly highest for the steers in lot 1. The profit above the cost of the steers and food was \$39.39 for lot 1 and \$11.14 for lot 2. Had No. 6 done as well as the others of lot 2 the profit for that lot would have been \$20.72.

Hence, both the gain in weight and the profit were larger on the more nitrogenous ration and the beef produced on it was valued at a

higher rate per pound. "The use of cut corn fodder instead of hay in feeding cattle may make the difference of a profit instead of a loss."

Steer feeding, J. H. CONNELL and J. W. CARSON (*Texas Sta. Bul. No. 27, June, 1893, pp. 313–321*).—Three experiments are reported on the feeding value for steers of boiled and roasted cotton seed, as compared with raw cotton seed, cotton-seed meal and hulls, and with rations containing no cotton seed. Each experiment included twenty native steers from 2 to 3 years old, which were divided in each case into five lots receiving the following food:

Lot 1, cotton-seed meal, cotton-seed hulls, and silage.
Lot 2, corn, roasted cotton seed, and hay.
Lot 3, corn, boiled cotton seed, and hay.
Lot 4, corn, raw cotton seed, and hay.
Lot 5, corn and hay.

The first experiment lasted fifty days, and each of the others one hundred days. Raw cotton seed cost $7 per ton; to this $2 per ton was added for the cost of boiling and $3 for roasting, the estimated cost of this treatment.

The authors' conclusions from the three experiments are given below:

(1) Roasted cotton seed does not have the laxative qualities of raw seed and is more palatable.

(2) Faster gains are made by feeding the boiled seed, but at a greater cost per pound of gain.

(3) The advantages to be gained in the use of roasted seed hardly justifies its general use.

(4) Boiled seed is more palatable than raw seed, less laxative, and makes faster gains. It may continue to be used with profit.

(5) Steers fed on raw seed, eating a less quantity of seed, ate slightly more hay in consequence.

(6) Cotton seed, at usual prices, is a good and cheap addition to a corn and hay ration.

(7) The best beef ration found by previous experiments, cotton-seed, meal hulls, and silage, is not here proven the best when calculated at former prices—raw seed, corn, and hay being better.

(8) When the value of raw seed is raised to near present market prices ($10 per ton), the meal, hulls, and silage is again the best ration, raw seed, corn, and hay being next best.

(9) The average cost of gain per pound in all lots at present price of foods was 3.64 cents.

(10) The cheapest feed per pound gained for all steers fed, when raw cotton seed is valued at $10 per ton, was raw seed, corn, and hay.

Skim milk as a food for calves, C. S. PLUMB (*Indiana Sta. Bul. No. 47, Nov., 1893, pp. 97–101*).—Four experiments are reported, two young calves being used in each experiment. In each of the first two experiments one calf was fed whole milk and the other skim milk; and in the last two experiments all the calves received skim milk. The several trials lasted from two to three months. No other food than milk was fed, except in the last experiment, where for a short time a little shorts or linseed meal was fed as a corrective rather than a food.

In the first two experiments the calves receiving skim milk made a slightly larger gain and consumed more milk than the calves receiving whole milk. On an average the calves fed skim milk alone gained 1 pound for each 15.6 pounds of skim milk consumed, which was sufficient to pay a good profit. With skim milk at 15 cents per hundred pounds, the profit on the six calves was $15.88.

The broad-tailed sheep of Persia, C. H. SHINN (*California Sta. Report for 1891–'92, pp. 202, 203*).—A description of this breed, of which the station owns two head.

VETERINARY SCIENCE AND PRACTICE.

J. F. DUGGAR, *Editor.*

Cerebro-spinal meningitis in horses, A. T. NEALE (*Delaware Sta. Report for 1891, pp. 11, 12*).—Record of an experiment in which cultures of the black mold (*Aspergillus niger*) were fed to a horse to determine if this fungus could produce cerebro-spinal meningitis. The results were all negative.

DAIRYING.

E. W. ALLEN, *Editor.*

Investigations relating to the manufacture of cheese, part I, L. L. VAN SLYKE (*New York State Sta. Bul. No. 60, n. ser., Oct., 1893, pp. 459–524*).—The investigations carried on by the station in 1893 are to be published in five parts, the last two parts including a summary of all the work done during the season, and the application of the results of the investigation to practical dairy problems.

Accounts of previous investigation in cheese-making have been published in Bulletins Nos. 50, 54, and 56 (new series) of the station (E. S. R., vol. IV, p. 945; V, pp. 85, 211).

The present bulletin, which is the first of this series for 1893, records the work done at a cheese factory at Mansville, New York. Twenty experiments were made in the months from April to September, inclusive. The milk used was from 750 cows, mostly grade Holsteins and natives. While it varied considerably in composition, it averaged 12.66 per cent of solids, 3.78 per cent of fat, and 3.12 per cent of casein and albumen for the season. The experiments were carried out at the factory, but samples of the milk, whey, and cheese were analyzed at the station. The full data for the twenty trials are tabulated and discussed. Some of the summarized results as to yield of cheese, loss of milk constituents, and effect of composition of milk on yield of cheese, are given below:

Loss of milk constituents in cheese-making.—The amount of milk solids in 100 pounds of milk that was lost in the whey in cheese making varied during the season

from 6.10 to 6.43 pounds and averaged 6.28 pounds; this was equivalent to from 48.12 to 52.17 per cent of the solids in the milk, with an average of 49.92 per cent.

The per cent of the solids in the milk lost in the whey diminished as the season advanced.

The amount of fat in 100 pounds of milk that was lost in the whey in cheese-making varied during the season from 0.26 to 0.50 pound and averaged 0.37 pound (nearly 6 ounces); this was equivalent to from 7.22 to 13.51 per cent of the fat in the milk, with an average of 10 per cent.

The proportion of fat in milk that was lost in cheese-making was entirely independent of the amount of fat in the milk. The variations in loss were due either to the condition of the milk or to some special conditions employed in manufacture.

The amount of casein and albumen in 100 pounds of milk that was lost in the whey in cheese-making varied during the season from 0.58 to 0.86 pound and averaged 0.74 pound.

Influence of composition of milk on yield of cheese.—From 100 pounds of milk there were made during the season from 9.19 to 10.76 pounds of green cheese, the average being 9.90 pounds.

From 9.29 to 10.99 pounds of milk were required to make 1 pound of cheese, 10.10 pounds being the average.

The amount of water retained in the cheese made from 100 pounds of milk varied during the season from 3.21 to 4.13 pounds and averaged 3.62 pounds.

The amount of fat retained in the cheese made from 100 pounds of milk varied during the season from 3.01 to 3.62 pounds and averaged 3.34 pounds. The variation in the amount of fat retained in the cheese made from 100 pounds of milk followed very closely the variation of fat in 100 pounds of milk.

The amount of casein retained in the cheese made from 100 pounds of milk varied during the season from 2.14 to 2.52 pounds and averaged 2.35 pounds.

When there was an increase of 1 pound of fat in the cheese there was, at the same time, an increase of three fourths of a pound of water in the cheese, and also an increase of about 0.64 pound of casein, taking the average of the season's work.

Actual and calculated yields of cheese.—The yield of cheese per 100 pounds of milk was calculated by multiplying the fat by 1.1 and the casein by 2.5, and adding the products. It was found by experiment that 1 pound of dry prepared casein absorbed water enough to increase the weight to 2.25 pounds, which, with the ash taken up in cheese-making, would make the weight about 2.5 pounds; *i. e.*, from 1 pound of casein in the milk practically 2.5 pounds of green cheese would be made. The following figures show the results of the calculation as compared with the actual yield:

Actual and calculated yields of cheese per 100 pounds of milk.

	April.	May.	June.	July.	August.	September.	Average for season.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Actual yield	9.43	9.78	9.79	9.84	10.13	10.50	9.91
Calculated yield	9.59	10.15	10.27	10.02	10.07	10.65	10.12

The calculated yield per 100 pounds of milk, divided by the product of the fat multiplied by 1.1, gives the calculated yield of green cheese per pound of fat in the milk. This averaged for all the trials 2.72 pounds, while the actual yield of cheese per pound of fat averaged 1.67 pounds.

Investigations relating to the manufacture of cheese, part II, L. L. VAN SLYKE (*New York State Sta. Bul. No. 61, n. ser., Nov., 1893, pp. 62*).—This bulletin records the results of experiments in cheese-making carried on at a factory in Verona, New York, during the season of 1893. As in previous investigations of this kind the analytical work was done at the station laboratory. Twenty-five experiments were made from April to October. The data for these experiments, including composition of the milk, whey, and green cheese, are fully tabulated and discussed. Some of the summarized results of the season's work are given below:

Loss of milk constituents in cheese-making.—The amount of milk solids in 100 pounds of milk that was lost in the whey in cheese-making varied during the season from 6.09 to 6.44 pounds and averaged 6.25 pounds; this was equivalent to from 46.54 to 53.40 per cent of the solids in the milk, with an average of 50.16 per cent.

The per cent of the solids in the milk lost in the whey diminished as the season advanced.

The amount of fat in 100 pounds of milk that was lost in the whey in cheese-making varied during the season from 0.24 to 0.42 pound and averaged 0.33 pound; this was equivalent to from 6.67 to 11.02 per cent of the fat in the milk, with an average of 9 per cent.

The proportion of fat in milk that was lost in cheese-making was entirely independent of the amount of fat in the milk. The variations in loss were due either to the condition of the milk or to some special conditions employed in manufacture.

The amount of casein and albumen in 100 pounds of milk that was lost in the whey in cheese-making varied during the season from 0.64 to 0.82 pound and averaged 0.74 pound; this was equivalent to from 23.10 to 26.07 per cent of the casein and albumen in the milk, with an average of 24.42 per cent.

The proportion of casein and albumen lost in cheese-making was, in general, very uniform, and was little influenced by variation in the condition of manufacture.

Influence of composition of milk on yield of cheese.—From 100 pounds of milk there were made during the season from 9.10 to 11.19 pounds of green cheese, the average being 9.90 pounds.

There were from 8.94 to 10.98 pounds of milk required to make 1 pound of cheese, 10.10 pounds being the average.

The amount of water retained in the cheese made from 100 pounds of milk varied during the season from 3.40 to 4.10 pounds and averaged 3.62 pounds.

The amount of fat retained in the cheese made from 100 pounds of milk varied during the season from 2.95 to 3.81 pounds and averaged 3.34 pounds. The variation in the amount of fat retained in the cheese made from 100 pounds of milk followed very closely the variation of fat in 100 pounds of milk.

The amount of casein and albumen retained in the cheese made from 100 pounds of milk varied during the season from 2.07 to 2.62 pounds and averaged 2.29 pounds.

For an increase of 1 pound of fat in the cheese there was, on an average, an increase of one third of 1 pound of water in the cheese and about 0.60 pound of casein.

For each pound of fat in milk the yield of cheese varied from 2.52 to 2.77 pounds and averaged 2.70 pounds during the season.

Manufacture of milk sugar, C. L. PENNY (*Delaware Sta. Report for 1891, pp. 104–108*).—The manufacture of milk sugar from skim milk has been studied in the laboratory with a view to finding a method suitable for creameries. As a result the following method is proposed:

The skim milk is heated in a suitable wooden or tin tank to about 120° F. To this for each 100 pounds of milk 1½ pounds of sulphate of alumina is added in the form

of a hot solution. The curd precipitates at once or in a very few minutes. The clear whey is then separated from the curd by filtering through wire gauze. It is next heated to not less than 180° and about one fourth pound powdered chalk to each 100 pounds of milk is added. The excess of sulphate of alumina is precipitated, together with some nitrogeneous matter in the whey not precipitated by the first treatment. From this precipitate a perfectly clear filtrate may be obtained, the large part by simply drawing off, the last portion by filtering through duck filters. This clear juice contains sugar, some sulphate of lime, and still a small residue of nitrogenous matter. * * * To prevent foaming, which would greatly retard the work or cause a loss of much of the sugar, a treatment with ground oak bark, or its extract, has been found thoroughly effective. It is indeed believed to be, if not a necessary part of the process, at least one that will greatly facilitate it and diminish the loss. From three to four pounds of ground bark for every 100 pounds of milk is found to be enough. Instead of the ground bark, from two fifths to one half pound of commercial tanner's extract of oak bark is more convenient and equally efficient. Boneblack also attains the same end, but it is not recommended on account of the time, trouble, and expense of the treatment. The whey thus purified is boiled in a vacuum pan just as are sugar juices. The crude, almost black, product is first boiled to prevent molding and afterward purified by being redissolved, passed hot over boneblack till it is colorless, and again evaporated to the point of crystallization. The purified sugar must be dry to prevent molding.

It is estimated that with this method about 65 per cent of the refined milk sugar in skim milk, or about 3¼ pounds of commercial milk sugar per 100 pounds of skim milk, can be recovered at a cost of about 13 cents per pound, which might be reduced with experience. The price of milk sugar during the year (1891) is quoted at 24 cents. The profit from working 5,000 pounds of skim milk per day, with milk sugar at 20 cents per pound, is calculated at $21.09, and with sugar at 15 cents, $12.96.

It is also believed that with actual experience the yield could be increased and the cost diminished from the figures given above, which are intended for the simplest form of plant, just such as is actually necessary to the profitable conduct of the business on a fairly large scale. The estimates are intended to be entirely safe and to overrate the expense and underrate the profit rather than the reverse.

AGRICULTURAL ENGINEERING.

Clearing land in the Sierra Foothills, G. HANSEN (*California Sta. Report for 1891–'92, pp. 190–192*).—Brief notes on the methods and costs of removing brush and trees from land.

Tests of the Keystone corn husker, A. T. NEALE (*Delaware Sta. Report for 1891, pp. 32–36, plates 2*).—Notes and data on the results of two tests of this husker. In one test it husked 14.95 bushels of corn per hour, under conditions not considered favorable. In the other test 177 bushels of corn were husked in eight hours and a half. The fodder from the husker did not keep.

STATION STATISTICS.

Report of treasurer of California Station (*California Sta. Report for 1891–'92, p. 316*).—This is for the fiscal year ending June 30, 1892.

Report of director of Connecticut Storrs Station (*Connecticut Storrs Sta. Report for 1892, pp. 8–16*).—Brief mention of the lines of work pursued during the year and a summary of the Annual Report for 1892.

Report of treasurer of Connecticut Storrs Station, H. C. MILES (*Connecticut Storrs Sta. Report for 1892, pp. 6, 7*).—This is for the fiscal year ending June 30, 1892.

Report of director of Delaware Station (*Delaware Sta. Report for 1891, pp. 7–37*).—This includes, besides accounts of work published elsewhere, a brief review of the work of the year, remarks on a proposed topographic survey of the State, and a reprint of work done by the U. S. Department of Agriculture on the oat blight, which was very prevalent in the State during the year.

Report of treasurer of Delaware Station (*Delaware Sta. Report for 1891, pp. 4, 5*).—This is for the fiscal year ending June 30, 1891.

List of publications of Texas Station (*Texas Sta. Bul. No. 27, June, 1893, pp. 322–324*).—A list of the 26 bulletins issued by the station from March, 1888, to March, 1893.

ABSTRACT OF PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE.

Ninth and Tenth Annual Reports of the Bureau of Animal Industry, (*Bureau of Animal Industry, Reports for 1891 and 1892, pp. 428, plates 19, figs. 7*).—This volume covers the operations of the Bureau for the years 1891 and 1892. Among the topics treated are the following: Inoculation experiments with swine plague, hog cholera, and glanders; inspection of meat and animals; experiments with mallein, tuberculin, and dehorning compounds; investigations relating to the treatment of lumpy jaw, or actinomycosis in cattle, a reprint from Bulletin No. 1 of the Bureau (E. S. R., vol. IV, p. 758); investigations into the nature, causation, and prevention of Southern cattle fever, a reprint from Bulletin No. 2 of the Bureau (E. S. R., vol. IV, p. 755); a report by J. A. Dodge on the condition of the poultry and egg industry in New England, New York, New Jersey, and Minnesota; breeding and growing the mule, by J. L. Jones; reports on contagious diseases among domestic animals in Austria, Sweden, Denmark, Russia, Italy, Greece, Turkey, Liberia, Madeira, Queensland, New South Wales, Philippine Islands, and Great Britain; supposed *maladie du coït* among horses in Nebraska, by G. C. Faville; the cattle and sheep industry in Colorado, by A. R. Kennedy; and "bottom disease" among horses of South Dakota, by E. C. Schroder.

Under reports from inspectors and correspondence the following subjects are treated: Abortion among mares, fatality among foals, condition of cattle in the Southwest, tapeworms among sheep in South Dakota, Angora goats, and diseases among Korean cattle. The laws of a number of States and Territories for the control of contagious and infectious diseases of domestic animals are quoted.

Report of the dairy industry of Denmark, C. C. GEORGESON (*Bureau of Animal Industry, Bul. No. 5, pp. 133, figs. 33*).—This is a report on a visit to Denmark made by the author under the auspices of this Department to investigate the dairy industry of that country. The author spent from January 27 to March 6, 1893, in that country, visiting representative creameries and dairy farms, institutions, laboratories, etc. The scope of the information gathered is shown by the table of contents, which includes facts about Denmark, development of the dairy, Danish dairy cattle, dairy implements and machinery, sys-

tems of creaming, treatment of the cream, churning, treatment of the butter, use of skim milk and buttermilk, descriptions of various estates, farms, creameries, etc., dairy bacteriology, state aid to dairy industry, markets for Danish dairy products, and agricultural and dairy education.

The area of Denmark is 14,553 English square miles, which is less than one tenth the size of the State of California or about half the size of the State of Maine. The population, in round numbers, is 2,000,000 people, giving 137 persons to the square mile. * * *

The total area of the country, excluding forests and waste land, and taking only what is under actual culture and in grass, is 6,843,805 acres, which makes the average size of the farm 30.55 acres. * * *

The output of dairy products during recent years from this little country has been astonishingly large. Statistics published by the government show that during 1891 Denmark exported 91,455,262 Danish pounds of butter, which amounts to 100,600,788 pounds avoirdupois.

[The author estimates the annual production of butter in Denmark, including the amount consumed at home, at 170,074,642 pounds.]

Interesting descriptions are given of seven estates, eleven smaller farms, the Milk Supply Company of Copenhagen, and six creameries which were visited. With reference to the Danish creameries the author says:

It is chiefly these that benefit the small farmers. They are patronized by men who, as a rule, keep but a limited number of cows, say from one to fifteen or twenty head, though occasionally the milk from much larger farms is also worked up in these creameries. It is from this class of creameries that the bulk of the export butter comes, and it is really these that fix the standing of Danish butter in foreign countries. There are two classes of creameries, which are distinguished from each other only in ownership, but which are alike in methods of operation and all other characteristics, and they can, therefore, be treated together under the above heading. The first class is the coöperative creamery proper, which is owned in company by all those who deliver milk there. The second class is the kind so largely represented in America in which the creamery plant is owned by one man, or at most by a few individuals, who buy the milk from the farmers of the neighborhood.

I have nowhere been able to obtain definite statistics in regard to the number of coöperative creameries in the country, but I have seen various estimates placing them at from 1,000 to 1,500, and I am inclined to believe that the latter figure is very nearly correct. The number of [non-coöperative] creameries, on the other hand, does not probably exceed 400. * * *

The constitution [of coöperative creamery associations] usually requires a minimum amount of oil cake to be fed daily to each cow, and this, of course, has to be bought. This raised the question of cost of feed and the return in milk from the feed given—questions which were to be closely studied. And now every Danish farmer interested in a coöperative creamery is able to tell to the fraction of a cent what his feed has cost him and what his returns in milk have been. Under the Fælles [non-coöperative] creamery system the farmers sold their milk directly to the creamery man. They were not particularly interested in the quality of the milk. No practical test had at that time been devised by which the amount of fat in the milk could be ascertained with ease and certainty. Under the coöperative system they soon recognized that the milk from some herds was worth more for butter than from others, and, since butter was the product aimed at, they all conceded the equity of paying for the milk in accordance with the per cent of fat it con-

tained. At this juncture Prof. Fjord came to their assistance by inventing his "control" apparatus [which is described in the bulletin], and his invention is now in use in every creamery in the land. Indirectly this testing apparatus led to the improvement of the cattle. When one farmer found that his neighbor received more money for his milk than he, it was natural to inquire into the cause which in most cases was traced to the cow herself. This, again, led to the organization of numerous societies for the improvement of the cattle, one form of which is represented by the "bull associations" already mentioned; and thus one question suggested another until the present standard has been reached. But they will by no means stop here. The same forces are still at work. Improvement in every line of the dairy interest is the ambition of the whole country. It is this wholesome development of the coöperative creameries which has increased the Danish exports of butter to the present astonishing figures, the amount having almost doubled during the last half dozen years.

In the chapter on dairy bacteriology the author mentions the work of Prof. V. Storch, director of the experimental laboratory at Copenhagen, on pure cultures in dairying. In reference to the preparation and use of these pure cultures, he says:

There were at the time of my visit three laboratories in which pure cultures were propagated and sold to the dairies. * * *

These dealers in the pure cultures keep their methods of propagation secret. The isolation of the germs can, of course, be accomplished by any bacteriologist; but they claim that it is only through a long series of experiments that they have hit upon a composition for the nutritive fluid in which to grow them to best advantage. It also requires certain forms of apparatus to which they may lay claim as inventors, and these features they do not propose to divulge, as it would probably increase competition to a point beyond profitable production. Moreover, I was informed that each form of these minute organisms had to be treated in a manner peculiar to itself, and as the several growers did not deal in the same bacterial forms, their methods of treatment in the laboratory were not alike. How many forms of the beneficial bacteria are in existence is at present unknown; but it is known that they are numerous. A dozen or more forms have already been discovered. * * *

The results of the use of these pure cultures have been so eminently satisfactory in practice that I found them in very common use. A new starter of these cultures is not needed every day or even every week; and as they are sold reasonably cheap, the expense connected with their use is but slight. When used according to directions sent with them they insure the production of a first quality of butter, which is of greater consideration than the expense their purchase involves. The three laboratories I have mentioned prescribe different methods of procedure in their use, which proves that there is no hard and fast rule that must be followed in order to obtain the desired results. That is, there is a possibility of the extension of this science far beyond our present knowledge of the subject. These artificial cultures are used more particularly in dairies which seem to be infected with injurious bacteria, and, to attain the best results, the cream should be sterilized before the ferment is added. The pure culture is added to a small portion of sterilized milk or cream, and then set aside at a given temperature until it has attained the proper growth. It is then further propagated in a still larger quantity of milk or cream, and, when a sufficient quantity has been obtained, it is added to the cream in the cream barrel, where it accomplishes the desired fermentation in from eighteen to twenty hours. At the time of my visit none of the laboratories had succeeded in devising means to perpetuate the ferment outside the laboratory for any length of time. * * *

In Denmark, where the cultures will be in transit at most only a couple of days before they reach their destination on the dairy farms, they are put up in a prepara-

tion of skim milk; but in shipping to this country, where they may be in transit for many weeks, they must be specially prepared in order to retain their activity the necessary length of time. * * *

I have had opportunity to see the effect of Mr. Quist's culture in this country. I bought samples of him, which he shipped to the Department of Agriculture. A portion of these samples was forwarded to me, and I tried them in the Belle Spring Creamery, owned by Mr. J. Nissley, the president of the Kansas Dairymen's Association.

The cream was not sterilized before the cultures were added, but they had a decided influence on the butter. Both Mr. Nissley and his butter-maker pronounced the quality superior to any they had made formerly, and they at once became converts to the process. * * *

The samples shipped by Mr. Quist were sent in three mediums—one a preparation of milk sugar, another in sterilized cotton, and the third in a nutritive fluid of his own invention. At the Belle Springs creamery we used only the first and the last of these. Although they had been in transit from March 10 until June 5, they appeared to be perfectly fresh and ready for business. The cotton preparation I did not try.

Food products, III, T. TAYLOR (*Division of Microscopy, Food Products, III, pp. 22, plates, 6*).—The bulletin contains the two following articles reprinted with revision from the Annual Report of the Secretary of Agriculture for 1891.

Improved methods of distinguishing between pure and fictitious lard (pp. 5, 6).—The methods depend on the behavior of the suspected lard when heated, and the crystalline groupings under the microscope. If a piece of fictitious lard the size of a pin head is compressed between two pieces of glass and observed with the naked eye, "it will exhibit many white spots, which represent the crystallized stearin, and which are not seen in pure lard. The amount of natural stearin in pure lard is so small that it is not visible to the unaided eye by this method of examination; therefore the microscope should be used in the examination of pure lard, as the groupings of the crystallized fats of lard are very small. These groupings are in stellar forms, composed of spicules which proceed from a common center, frequently requiring to be magnified 400 times to discern them, while the grouping of branched crystals of stearin are easily observed to advantage under a power 100 diameters."

A plate is given, showing the appearance of pure and adulterated lard under the microscope.

Four edible mushrooms of the United States (pp. 7–22).—Methods adapted from the published reports of foreign and home growers are given for the culture of mushrooms. Four species of edible mushrooms are described and figured by colored plates, as follows: *Agaricus melleus*, *A. deliciosus*, *Cantharellus cibarius*, and *Fistulina hepatica*. A chapter is given to the structural characters of the various orders of mushrooms. A glossary is given explaining the technical terms used in the description of such fungi.

Crops of the year (*Division of Statistics, Report No. 111, n. ser., Dec., 1893, pp. 459–521*).—Notes and tabulated data regarding the meteorological conditions affecting crops in the United States in 1893; the general history of the crops of the year; estimates relative to the area,

product, and value of corn, wheat, oats, rye, barley, buckwheat, potatoes, hay, and tobacco; farm prices and wholesale prices at leading cities; agricultural exports and imports; notes on foreign agriculture, and freight rates of transportation companies.

The following tables give the yield, area, and value of the principal crops, and the value of exports and imports of agricultural products in 1892 and 1893:

Yield, area, and value of corn, wheat, oats, rye, barley, buckwheat, tobacco, potatoes, and hay.

	Total yield.	Total area.	Total value.	Average value per bushel.	Average yield per acre.	Average value per acre.
CORN.	*Bushels.*	*Acres.*	*Dollars.*	*Cents.*	*Bushels.*	
Average, 1870–'79	1,184,486,954	43,741,331	504,571,048	42.6	27.1	$11.54
Average, 1880–'89	1,703,443,054	70,543,457	668,942,370	39.3	24.1	9.48
1893	1,619,496,131	72,036,465	591,625,627	36.5	22.5	8.21
WHEAT.						
Average, 1870–'79	312,152,728	25,187,414	327,407,258	104.9	12.4	13.00
Average, 1880–'89	449,695,359	37,279,162	371,809,504	82.7	12.1	9.97
1893	396,131,725	34,629,418	213,171,381	53.8	11.4	6.16
OATS.						
Average, 1870–'79	314,441,178	11,076,822	111,075,223	35.3	28.4	10.03
Average, 1880–'89	584,395,839	21,996,376	180,866,412	30.9	26.6	8.22
1893	638,854,850	27,273,033	187,576,092	29.4	23.4	6.88
RYE.						
1893	26,555,446	2,038,485	13,612,222	51.3	13.0	6.68
BARLEY.						
1893	69,869,495	3,220,371	28,729,386	41.1	21.7	8.92
BUCKWHEAT.						
1893	12,132,311	815,614	7,074,450	58.3	14.88	8.67
TOBACCO.						
1893 ....pounds..	483,023,963	702,952	39,155,442	....	....	55.70
POTATOES.						
1893	183,034,203	2,605,186	108,661,801	59.0	72.2	41.71
HAY.						
1893 ....tons..	65,766,158	49,613,469	570,882,872	....	....	11.50

Exports and imports of agricultural products for the years ending June 30, 1992, and 1893.

Article.	1892.	1893.
EXPORTS.		
Animals and animal matter	$181,730,463	$171,285,887
Bread and breadstuffs	299,363,117	200,311,654
Cotton and cotton-seed oil	263,443,526	192,757,264
Miscellaneous products	54,791,126	50,998,576
Total agricultural exports	799,328,232	615,353,381
Total exports	1,015,732,011	830,876,908
IMPORTS.		
Sugar and molasses	107,286.557	118,248,118
Tea, coffee, and cocoa	145,758,771	98,544,510
Animals and their products, except wool	39,913,808	41,244,073
Fibers, animal and vegetable	67,089,048	76,961,520
Miscellaneous	66,811,677	78,891,969
Total agricultural imports	426,859,861	413,890,190
Total imports	827,402,462	866,400,922

ABSTRACTS OF REPORTS OF FOREIGN INVESTIGATIONS.

A new method for the quantitative determination of pentoses in plants, E. HOTTER (*Chem. Ztg., 17* (*1893*), *No. 95*, *pp. 1743–1745*).—The author uses pyrogallol instead of phenylhydrazin for precipitating the furfurol formed, and proceeds as follows: Five to 10 grams of material containing pentoses is distilled with hydrochloric acid of 1.06 specific gravity until the distillate fails to show a reaction for furfurol with aniline acetate. The distillate is diluted to a definite volume (400 or 500 c. c.) with the same or somewhat stronger hydrochloric acid, and an aliquot of 20 to 30 c. c. is heated with an excess of pyrogallol (0.5 to 1 gram) in a closed tube at 100° to 110° C. for from one to two hours. The precipitate thus formed is brought on a tared filter, washed, dried at 103° C., and weighed. The weight of the precipitate divided by 1.974 gives the amount of furfurol in the aliquot, from which the percentage of pentoses is found by the ordinary calculation. The presence of a large excess of pyrogallol is said to do no harm, and under the provisions prescribed the reaction between it and the furfurol is said to be quantitative. The reaction becomes more rapid and more complete as the solution of furfurol becomes more concentrated. It is important that a sufficient quantity of condensed furfurol solution be taken, and that the furforol solution contain at least 12 per cent of hydrochloric acid. The author suggests carrying on the distillation with hydrochloric acid under diminished pressure, to prevent the formation of humic substances.

What advantages the method possesses over the methods proposed by Tollens and his students, Stone, and others, in which the furfurol is determined by phenylhydrazin, does not appear from the article.—E. W. A.

Determination of crude fiber, V. STEIN (*Ugeskr. f. Landmänd, 39* (*1893*), *pp. 706*, *707*).—The method of determining crude fiber in cereals adopted by the author is as follows: The finely ground sample is treated with a decoction of malt and the soluble carbohydrates completely removed by washing with distilled water. The residue is treated with a 1 per cent soda solution at ordinary temperature.* After standing and washing it is treated with a 1 per cent hydrochloric acid solution,

* Quantity of solution and length of time of digestion not given in the paper.

left to settle, and washed. The residue is transferred to a weighed ash-free filter, washed with alcohol and ether, dried, and weighed. Nitrogen and ash are determined in the residue and deducted.

The results are stated to be higher than by the ordinary Weende method. The analyses given of samples of barley show 9.26 to 14.08 per cent of crude fiber, determined according to the method described.—F. W. W.

The chemistry of carbonic acid assimilation by chlorophyll-bearing plants, M. A. BACH (*Monit. Scient., 17 (1893), p. 669; abs. in Chem. Ztg., 17 (1893), Rep. p. 252*).—The author assumes that the carbonic acid comes to the plant as H_2CO_3. From the analogy of the composition of sulphurous acid (which in sunlight breaks up into the following equation: $3H_2\ SO_3 = 2H_2\ SO_4 + S + H_2O$), he reasons that three molecules of carbonic acid yield an unstable compound and formic aldehyde, as follows: $3H_2\ CO_3 = 2H_2\ CO_4 + C + H_2O = 2H_2\ CO_3 + O_2 + CH_2O$. This process is similar to the action of carbonic acid in a solution of acetate of uranium under the influence of sunlight. Here the carbonic acid is broken up into an oxydizing and a reducing body; also if one mixes a solution of acetate of uranium and dimethylanilin, the introduction of an oxydizing body from carbonic acid transforms the dimethylanilin into methyl violet in a similar way.—W. H. E.

The production of ammonia in the soil by microbes, E. MARCHAL (*Bul. Acad. Roy. Belgique, 25 (1893), ser. 3, pp. 727–771, figs. 2*).—It is the current belief that the higher orders of plants are not able to utilize as food the complex organic compounds of the soil, but that these substances must be reduced to their more simple components before they can be assimilated by such plants.

Comparatively recent investigations have shown that these transformations are effected largely, if not exclusively, by the inferior organisms which inhabit the surface layers of the soil. As regards the nitrogenous matter the rôle of these organisms is to produce from the organic nitrogen first ammonia, then nitrites, and finally nitrates. The last two stages of this process, *i. e.*, the formation of nitrites and of nitrates, have been clearly explained by the work of Schlösing and Müntz, P. Frankland, Warington, and Winogradsky; but the first stage, up to within a comparatively recent date,* has been but imperfectly understood, and it is to the elucidation of this phase of the subject that the author addresses his efforts.

To accomplish this object he (1) isolated from soils the species of organisms (molds, yeast forms, and bacteria) which were the most prevalent, and (2) determined which of these had the power of transforming nitrogenous matter into ammonia. For isolating the organisms of the soil he used Koch's method. From each sample of soil not less than two cultures were made, one on alkaline gelatin with bouillon and

*See Müntz and Coudon: La fermentation ammoniacale de la terre, Ann Agron., 19 (1893), No. 5, pp. 209–216 (E. S. R., vol. IV, p. 860).

peptone, and the other on gelatin and slightly acid prune extract for the purpose of studying the molds and yeasts. Tests were made on various kinds of soils—sandy, humus, and calcareous arable soils (manured and unmanured), soils of the landes, and forest soils, as well as on various manures, composts, etc., from the region around Brussels. These cultures furnished more than 30 species of bacteria and a score each of molds and yeast forms.

A large number of these species were inoculated in dilute solutions of egg albumen* in order to determine the part which they play in ammoniacal fermentation. Fifteen or more of the species of bacteria were found to produce ammonia energetically, the most active being *Bacillus mycoïdes* (*Erde Bacillus* of German authors), which in twenty days produced 0.64 gram of ammonia per liter of culture solution—nearly half of the amount originally present in organic form.

In similar experiments with 33 species of molds and yeasts it was found that in every case where development was normal there was a production of ammonia. The actual amounts of ammonia produced were determined in the case of 5 species, the most active being *Cephalothecium roseum*, which produced 0.5 gram of ammoniacal nitrogen per liter in fifteen days.

The *Bacillus mycoïdes* was selected for special investigation. This microörganism is very widely distributed in nature. It is always present in the surface layers of cultivated soils; and it is found frequently in manure, in vegetable mold, in composts, and in the humus of forests. It has been observed also in the air and in natural waters. Its microscopic and macroscopic characters are described in detail, and accounts are given of cultures in various media. The apparatus used and results obtained in experiments to determine the action of this bacillus on albumen and other nitrogenous substances, under varying conditions of temperature, aëration. reaction of medium, and concentration of solution, are minutely described. Observations on its action on carbohydrates and on the power which it possesses under certain conditions of reducing nitrates were also made.

The general conclusions arrived at from these investigations are as follows: The gradual oxidation in the soil of the nitrogen of organic substances to nitrates (nitrification) is accomplished in three main phases: (1) "Ammonisation," or transformation of organic nitrogen into ammonia; (2) "nitrosation," or transformation of ammonia into nitrites; and (3) "nitration," or transformation of nitrites into nitrates.

Ammonisation is accomplished essentially by the action of various organisms (bacteria, yeasts, and molds) which infest the surface layers of the soil.

In arable soil the action of bacteria is predominant. In acid humus soils the molds are responsible for an important part of the phenomena.

*Containing 2 grams per liter of albuminoid nitrogen.

Among the bacteria of arable soil the *Bacillus mycoïdes*, or soil bacillus, is by far the most prevalent and most active in the reduction of organic matter.

Under the influence of this microbe oxygen is carried to the elements of albumen, the carbon is transformed into carbonic acid, the sulphur into sulphuric acid, and the hydrogen partially into water, leaving ammonia as a residue of the oxidation. Peptones, leucin, tyrosin, and aromatic fatty acids are also produced in small quantities.

The best conditions for promoting the activity of the "ammonisating" microbe are as follows: (1) A temperature of about 30° C., (2) thorough aëration, (3) a slightly alkaline medium, and (4) a dilute solution of albuminoids.

The *Bacillus mycoïdes* has been observed to have the power of transforming not only the nitrogen of egg albumen into ammonia, but also that of casein, fibrin, legumin, gluten, myosin, serin, and peptones. Creatin, leucin, tyrosin, and asparagin undergo the same changes, but urea and nitrate of urea, as well as ammoniacal salts, are not attacked by the microbe, for which they do not appear to be suitable food.

The *Bacillus mycoïdes*, which is ammonisating and aërobic in presence of nitrogenous organic matter, becomes denitrifying and anaërobic when present in a medium of easily reducible substances (nitrates). In the absence of free oxygen in solutions containing an organic substance (sugar or albumen), it reduces nitrates to nitrites and these to ammonia. It is therefore capable of generating ammonia by two diametrically opposite processes—oxidation in one case and reduction in the other.—W. H. B.

A contribution to the nitrogen question, A. PETERMANN (*Bul. Acad. Roy. Belgique, 25 (1893), ser. 3, pp. 267–276, plate 1*).—From the experiments conducted in 1889 and 1890 the author drew the following conclusions: (1) When yellow lupines, dwarf beans, or spring barley are grown in normal air in a culture medium poor in nitrogen but rich in mineral materials and bacteria of the soil, there will be found an important gain of nitrogen in the plant, roots, and soil, due to the intervention of the air. (2) Similar phenomena are observed when plants are grown under similar conditions, except that the air contains less than the normal amount of nitrogen.

In 1892, at Gembloux, the author conducted a series of experiments from June 11 to July 27 to test the gain or loss of nitrogen during that time. Barley was the only culture crop used in the experiments, the details and apparatus for which are fully described.

In the first experiment the soil was not sterilized nor cultivated, but various algæ developed on its surface in contact with air deprived of all its combined nitrogen. The amount of nitrogen was ascertained at the beginning and end of the experiment and a gain of 0.0039 gram found. In the second experiment the soil was sterilized, was not cultivated, remained sterile throughout the experiment, and was in constant

contact with the air freed of its combined nitrogen. In this experiment there was a loss of 0.0015 gram of nitrogen from the soil. In the third experiment the soil was sterilized, remaining so throughout the experiment, and was cultivated with barley to which air containing no combined nitrogen was admitted. At the end of the experiment there was shown to have been a loss of 0.0017 gram of nitrogen. The fourth experiment was vitiated through an accident. In the fifth experiment the soil was sterilized, not cultivated, watered with sterilized water, kept free from cryptogamic vegetation, and exposed to the ordinary atmospheric conditions of the greenhouse. At the end a loss of 0.0008 gram of nitrogen was noted. In the sixth and last experiment the soil was unsterilized, not cultivated, watered with unsterilized rain water, exposed to the ordinary atmospheric conditions of the greenhouse, and allowed to cover itself with cryptogamic vegetation. At the end of this experiment there was a gain of 0.0031 gram of nitrogen.

From these experiments it is shown that soil entirely destitute of vegetation is unable to fix any of the free nitrogen of the air. The cultivation of barley in sterilized soil, under a bell jar, and supplied with air from which all combined nitrogen had been removed, showed no gain; while in the first and last experiments, where various cryptogamic plants were permitted to cover the soil, important gains were shown.

The author's conclusions are as follows: The atmosphere participates in plant growth not only by its nitrogenous combinations but also through its free nitrogen. This participation is not direct, as the experiments show that the free nitrogen was not fixed either by the plants of high rank (barley) or by the bare soil. The free nitrogen enters into the life cycle of plants through the intervention of microörganisms inhabiting the soil. These cryptogamic plants which develop spontaneously over the surface of moist soil, and the microbic action operating through root tubercles, are the means by which the free nitrogen of the air is fixed. The first are a general and the second a special case of fixation.—W. H. E.

Vegetation in an atmosphere devoid of oxygen, T. L. PHIPSON, (*Chem. News, 68 (1893), No. 1775, pp. 259, 260*).—In a series of papers the author has endeavored to show, by experimental proof, that in the progression of life plants must of necessity have preceded animal life, and that the oxygen of the air owes its presence mainly, perhaps entirely, to the decomposition of carbon dioxide by plants.

The author grew a plant of *Convolvulus arvensis* in an atmosphere devoid of oxygen, while two other plants of the same species grew alongside of the apparatus in the ordinary atmosphere. The apparatus consisted of a graduated tube, wide enough to admit the plant readily, standing over a vessel of water containing minute quantities of substances known or supposed to be useful to the growth of the plant. Carbonic acid was supplied daily through saturation from a second tube.

The whole was exposed for ninety-eight days to a north light in a room whose temperature varied from 15° to 30° C. Half the water in the basin was covered so as to secure darkness for the roots.

The little plant was introduced into the tube July 25. Previously 75 c. c. of pure nitrogen had been placed in the tube, which, with the plant, made the contents 102 c. c. The quantity of carbonic acid and vapor fluctuated from time to time, according to temperature and pressure. The amount of growth the plant made from time to time is given. On October 2 the test, as well as the two check plants, began to turn yellow, assuming their autumn tints, and on October 30 all were dead.

The gas in the tube at this time measured 95 c. c. and upon analysis gave nitrogen 75 c. c., the original amount, oxygen 20 c. c., and carbonic acid, none. The plant in the tube grew to more than three times its original height, not counting its natural curvings, and the analysis showed an atmosphere in the tube richer in oxygen than ordinary atmospheric air.

The author concludes that if there was an excessive supply of carbonic acid and if plants did not deteriorate, the oxygen of the air, due to plant life alone, would increase from year to year, and that the present equilibrium in the elements of the air is apparent, not real.—W. H. E.

[In a recent note in *Chemiker Zeitung* (17, No. 99, p. 1831), Dr. G. Meyer claims to have advanced the idea that the atmospheric oxygen is due to vegetation, in a paper published in 1891.—ED.]

The nuclei of yeast cells, F. A. JANSSENS (*Centbl. Bakt. und Par., 13 (1893), pp. 639–642; abs. in Bot. Centbl., 56 (1893), No. 10, p. 293*).—The author claims that by the use of suitable methods, not given in the abstract, he has found in some yeast cells indubitable nuclei. The karyokinetic figures were also observed. The spore formation repeatedly showed the divisions of the nucleus.—W. H. E.

The influence of calcium sulphite and potassium bisulphite on alcoholic fermentation, F. RAVIZZA (*Staz. Sper. Agr. Ital., 24 (1893), No. 6, p. 593; abs. in Chem. Ztg., 17 (1893), No. 25, Repert., p. 285*).—The author experimented with an artificial must made from white grapes. To equal quantities of the must was added calcium sulphite in quantities varying from 0.15 gram to 1.2 gram per liter. The temperature during the first part of the experiment was kept at 30° C. and in the second part at 14° C. In a similar manner the author treated must with potassium bisulphite, the quantity varying from 0.15 gram to 0.5 gram per liter. The progress of the fermentation was noted daily, the vessels daily shaken, and the amount of carbon dioxide noted. The author records the following results:

A small quantity of calcium sulphite neither lowered the temperature nor prevented fermentation. An influence upon fermentation follows an addition of a considerable quantity of the salt, so that the good quality of the wine may be destroyed. On this account the use

of it in alcoholic fermentation in southern countries is condemned. A still greater influence upon the fermentation follows the use of potassium bisulphite.—W. H. E.

Boracic acid in hops, O. HABERMANN (*Allgem. Brauer- u. Hopfenztg, 1893, No. 33, p. 1781; abs. in Chem. Ztg., 17 (1893), No. 25, Repert., p. 285*).—Wittstein was the first to point out the capability of plants to extract boracic acid from the soil. He found in the ash of the seed of *Mæsa picta*, an Abyssinian primula, 0.35 per cent of boracic acid. The author recently investigated quite a range of varieties of hops, among them Bavarian, Bohemian, Transylvanian, French, and Styrian varieties. He affirms that all contain boracic acid, while he found the ash of malt entirely free from it, confirming the result of the previous investigations of J. Brand* concerning this subject.—W. H. E.

Soil inoculation for leguminous plants, FRUWIRTH (*Deut. landw. Presse, 18 (1891), No. 15, pp. 127, 128; 19 (1892), No. 1, p. 6; No. 2, pp. 14, 15; 20 (1893), No. 18, p. 171*).—In 1889 the author began a series of experiments to test the effect on leguminous plants of inoculating the soil in which they were grown with soil from plats which had previously borne these crops. Both pots and plats were used by the author, the latter being either 4½ or 6 square meters in area.

White lupine.—In May, 1889, the author planted seed of white lupine in soil to which soil from a lupine field had been added a few days previously. On account of unfavorable conditions the crop failed on the plats which were thus inoculated as well as on those which had not been inoculated, but the inoculated plats made a better growth than those which had not been thus treated.

In 1890 white lupines grown in inoculated and uninoculated soil yielded seed as follows: Three plants growing in a pot of inoculated lime soil gave 18.3 grams of seed, and 4 plants in a corresponding soil not inoculated, 4.77 grams; 4 plants in a pot of inoculated clay soil gave 49.7 grams, and the same number of plants in a corresponding soil not inoculated 26.2 grams, and in another case 3 plants in an inoculated lime soil yielded 36.49 grams, while the same number of plants in a similar soil not inoculated yielded 2.37 grams. These figures show a far better average result for the plants growing in inoculated soil. In this year the plat experiments were also decidedly favorable to the lupines growing on inoculated soil, as shown by the following table:

Yield of lupine seed on inoculated and uninoculated soil.

	Grams.
Plat No. 12, inoculated	429.38
Plat No. 11, inoculated with half the quantity of earth used on No. 12	369.55
Plat No. 55, not inoculated	225.56
Plat No. 56, not inoculated	219.50

The above figures seem to indicate not only that inoculation had a favorable effect, but that the quantity of soil used for this purpose exercised an influence on the yield.

* Chem. Ztg., 16 (1892), No. 101, Repert., p. 350.

In 1891 the same pots and plats were used as in former years, the inoculation having been made in 1889 and not renewed. In the two series of plats on which the growth of the plants was normal the yield of seed was much greater on inoculated soil than on uninoculated. The following table shows the weights of air-dry stems, leaves, hulls, and seed on plats 4½ square meters in area, on which the number of plants ranged from 114 to 118 per plat:

Yield of white lupines on inoculated and on uninoculated soil.

No. of plat.	Treatment.	Stems, leaves, and hulls per plat.	Stems, leaves, and hulls per plant.	Seed per plat.	Seed per plant.	Average height of plants.
		Grams.	*Grams.*	*Grams.*	*Grams.*	*Cm.*
55	Not inoculated	857.1	7.47	285.7	2.48	40
56	Not inoculated	839.3	7.17	267.8	2.28	45
61	Not inoculated	473.2	4.15	232.1	2.03	36
11	Inoculated with about 1,600 pounds of earth per acre	1,416.8	12.30	273.0	2.37	52
12	Inoculated with about 3,200 pounds of earth per acre	2,312.0	19.59	386.7	3.28	52

The experiments with white lupines were repeated in 1892 for the fourth time on the same plats, and on two new plats which had grown a catch crop of lupines in the preceding autumn and were thus presumably slightly inoculated. The number of plants on different plats varied between 176 and 200. Plat 11 had been inoculated in 1889 with 1,600 pounds of earth per acre, and plat 12 with 3,200 pounds, and both had been seeded to lupines without subsequent inoculation each year since. In 1892 plat 11 yielded 345 grams of seed and 839 grams of straw and hulls; and plat 12 (more strongly inoculated) 381 grams of seed and 889 grams of straw. The above plats, which had grown lupines for four years, showed lupine sickness, which explains their smaller yield as compared with plats 13 and 14, which had borne lupines only two years and which had been inoculated with only 80 pounds of earth per acre in 1891. The yields of these last two plats were 495 and 478.5 grams of grain, and 1,039 and 1,089 grams of hay and straw. Two plats not inoculated yielded only 14 grams of grain each and 439 and 500 grams of straw and hulls.

Serradella and lentils.—In 1891 two plats of serradella were inoculated with about 80 pounds of earth per acre taken from a serradella field, and two plats remained uninoculated. The weights of air-dry stems, leaves, and seed were as follows:

Yield of serradella on inoculated and uninoculated soil.

	Grams.
Plat 15, inoculated; crop harvested August 9	554.5
Plat 60, not inoculated; crop harvested August 9	145.1
Plat 16, inoculated; crop harvested September 14	442.6
Plat 59, not inoculated; crop harvested September 14	312.5

Tubercles were found on the roots of the plants growing in inoculated soil, but these were wanting elsewhere.

In the same year the above amounts of inoculation material were used on plats of lentil (*Ervum monanthos*). With this plant only the yield of seed was determined, of which the average weight on the two inoculated plats was but slightly greater than the yield on the uninoculated plat.

Thus it appears that the author's experiments in 1891 clearly showed the value of soil inoculation for lupines and serradella, but the results were less clear in the case of lentils. On this account some of the experiments of 1891 were repeated in 1892, for which year the results are summarized below.

On plats with an area of 6 square meters, inoculated in 1891 and used for the same experiments in that year, seed of serradella and lentils were separately sown in March, 1892. The serradella was cut September 17. The collective weights of stems, leaves, and seed of serradella on the two inoculated plats were 358 and 304 grams, respectively; and on the two uninoculated plats, 202 and 240 grams, respectively. Though this yield was smaller than that of the preceding year, it showed clearly, as then, the favorable influence of soil inoculation for serradella. The yield of lentils was as follows:

Yield of lentils on inoculated and uninoculated soil.

No. of plat.	Treatment.	Seed.	Straw and hulls.
		Grams.	*Grams.*
17	Inoculated	673	866
18	Inoculated	406	831
62	Not inoculated	263	576

The yields were larger than in 1891 and showed more plainly the effect of inoculation. Neither in 1891 nor in 1892 were the yields of serradella and lentils satisfactory on the inoculated or on the uninoculated plats.—J. F. D.

Fertilizers, F. T. SHUTT (*Canada Experimental Farms, Report for 1892, pp. 122–134*).—Brief general statements regarding the principles underlying the use of fertilizers are followed by a discussion, accompanied by original and compiled analyses, on the nature, care, and uses of barnyard manure. Analyses of the following fertilizing materials are also tabulated and discussed: Superphosphate of lime, bone meal, bone char screenings, fish manure, codfish bone, and marl (8 samples).

The resistance of certain field crops to drought, P. P. DEHÉRAIN (*Ann. Agron., 19 (1893), No. 12, pp. 561–579*).—The year 1893 was marked by an exceptionally dry spring, which exerted a disastrous influence on certain species of plants, while others were much less seriously affected. Observations in different parts of France show that, as a rule, hay meadows totally failed, oats seeded in March on soils still containing some moisture germinated but made a poor growth, clover did not germinate, and fields of sugar beets remained bare except for

a few sickly plants; but that wheat remained green, continued to grow, and in July and August gave a yield which is estimated for France at 97 millions of hectoliters. Investigations to determine the causes of these differences were undertaken on soils bearing forage plants and wheat, both in vegetation cases* and in plats. With the assistance of Demoussy and Dumont physical analyses of the soils, as well as their moisture content at different depths down to 1 meter below the surface, were made, showing that following the drought of March and April, the percentage of moisture varied from 2 to 6.6, amounts wholly insufficient for germination, and explaining why the beet seed and clover seed remained inert. All the observations showed, however, that the extreme dryness was confined to the upper layers of the soil, while at lower depth the soil still retained notable amounts of water. They showed further that the grasses of hay meadows were more sensitive to this superficial drying than wheat. This is explained by observations made on wheat plants growing in vegetation cases and in natural soil showing that the roots went down from 1.2 to 2 meters in search of moisture. Wheat is commonly considered a short-rooted plant, but these investigations show that while it has a large tuft of superficial roots there are always a certain number of filaments which descend vertically and do not commence to ramify until they have attained a depth of 75 centimeters. These ramifications are more numerous than in the surface roots, and it appears that they are more active since they are more plentifully supplied with absorbing root hairs. These roots, moreover, were maintained in these lower layers of the soil, although later in the season abundant rains made the surface soil more moist than the deeper layers.

The investigations all go to show that wheat sends down its roots into the subsoil, and is thus able to withstand drought. By comparing the yields in the vegetation boxes and on the plats the conclusion is reached that wheat will not give a good yield where the development of the roots is interfered with.

On the other hand, similar observations on rye grass as a fair representative of the meadow grasses† showed that the roots of this plant did not descend lower than 75 centimeters, and they were largely grouped in thick tufts or spread out in infinite ramifications in the surface soil. This plant therefore succumbed to the drought because it was not able to draw on the moisture of the subsoil. Clover, as already stated, failed to germinate, and the crop was a complete failure in France except on moist soil, but a study of its root development during the season of 1892, when the growth was good, showed that the roots did not extend lower than one meter. It is interesting to observe that,

* One meter deep, 2 meters square, and containing about 5 tons of earth (E. S. R., vol. IV, p. 682).

† In France the principal *Graminea* of grass lands is Italian rye grass (*Lolium italicum*).

contrary to the accepted belief, it was found that the roots of wheat grew to a greater depth and were longer than those of clover.—W. H. B.

Experiments with field crops in 1891, T. SHAW and C. A. ZAVITZ (*Ontario Agl. College and Exptl. Farm, Report for 1891, pp. 61–106*).—The following experiments were conducted on the college farm: Tests of 63 varieties of barley, 53 of spring wheat, 41 of winter wheat, 108 of oats, 6 of peas, 25 of potatoes, 42 of Swedish turnips, 15 of fall turnips, 36 of mangel-wurzels, 15 of carrots, and 4 of sugar beets, and 76 of corn grown for silage; experiments with barley, spring wheat, and oats sown separately and in mixtures; depths of planting potatoes; dates for sowing barley and spring wheat; roots grown on flat and ridged land; Swedish turnips, mangel-wurzels, and sugar beets grown at different distances; the effect of salt as a fertilizer on barley, oats, rape, and fodder corn; growing fodder corn in hills and drills; and fertilizers for rape. Millet, millo maize, Kaffir corn, clover, and mustard were also grown.

In every case where oats, barley, and wheat were sown in mixtures the yield of grain and straw was considerably greater than when they were sown separately.

In a test of 15 varieties of fall turnips the average yield per acre of the white-fleshed varieties was 25.6 tons and of the varieties with yellow flesh 20.22 tons.

The distinctively long varieties of mangel-wurzels averaged 28.57 tons per acre, while the Globe varieties yielded 22.42 tons.

In this year Swedish turnips, mangel-wurzels, and sugar beets were grown in drills at different distances. With all three crops a distance of 16 inches between the drills gave better results than distances of 24 and 28 inches.

On loam and marl soils the yield of rape was largely increased by the use of salt as a fertilizer. On clay and muck, salt increased the yield but slightly. Rape was thinned so as to leave a plant 1, 2, 4, 8, and 12 inches apart in the drill. The largest yield was secured from the plants left 2 inches apart.

White mustard was grown at the rate of 750 pounds per acre. For this crop drills 15 inches apart were more satisfactory than broadcast sowing.—J. F. D.

Experiments with field crops in 1892, T. SHAW and C. A. ZAVITZ (*Ontario Agl. College and Exptl. Farm, Report for 1892, pp. 48–115*).—These include tests of 67 varieties of barley, 57 of peas, 63 of spring wheat, 44 of winter wheat, 116 of oats, 114 of potatoes, 44 of Swedish turnips, 18 of fall turnips, 38 of mangel-wurzels, 23 of carrots, 10 of sugar beets, 73 of fodder corn, 11 of millet, 18 of clover and kindred plants, 40 of grasses, and 3 of sunflowers. One plat of flax, 1 of buckwheat, and 1 of *Lathyrus sylvestris* were also grown. Besides the variety tests, the following experiments were conducted: Dates of seeding barley, peas, spring wheat, and oats; fertilizers for winter wheat; effect of selecting seed of barley and peas; dates for harvesting barley,

peas, spring wheat, and oats; depths of planting potatoes; whole potatoes against cuttings planted at different distances; dates for planting potatoes; fertilizers for potatoes; yield of mangel-wurzels, turnips, carrots, and fodder corn at different distances; and mixed grains for fodder purposes. A popular discussion of the culture and uses of rape is given.

The Manshury variety of barley gave the largest yield in 1891 and 1892, as well as the highest average for four years. The average yield per acre of the two rowed varieties for four years was 44.8 bushels and of the six-rowed varieties 49.1 bushels. The average weight per bushel was 51.8 pounds for the two-rowed varieties and 51.1 pounds for the six-rowed varieties.

Peas were sown at different dates between April 22 and June 6. The weight of peas per bushel increased with each successive seeding.

Oats were sown at different dates between April 22 and June 6. The yield decreased with each successive seeding.

In a test of 44 varieties of winter wheat the white chaff varieties averaged 42.30 bushels per acre and the red chaff 43.51 bushels.

In 1892 the yield of the bearded varieties exceeded that of the bald varieties by 5 bushels per acre, while in 1891 the bald varieties yielded 9.9 bushels per acre more than the bearded. This is taken as an indication that in seasons when the conditions are not really favorable the bearded varieties will yield more than the bald. In three years the average yield of the red and white varieties was about 1 bushel per acre in favor of the white, and the red weighed from 1 to 2 pounds more per bushel than the white.

Among the 116 varieties of oats tested the varieties which came to maturity earliest gave, on an average, a larger yield than those which matured late. The varieties having straw over 60 inches in height gave a smaller yield than those having straw less than 40 inches in height.

Large grains, small grains, and broken grains of hulless barley were planted. The yields per acre were 26.98, 18.12, and 13.64 bushels, respectively.

The yield from sowing whole peas was more than double that from cracked peas.

When potatoes were planted at depths of 1, 3, 5, and 7 inches the yield increased in every instance with the depth. Whole small potatoes and various sized pieces of large and medium sized potatoes were planted at distances from 1 to 3 feet in drills. After deducting the seed the best yield was obtained from the medium whole potatoes planted 1 foot apart. The smallest potatoes were obtained from the seed ends and from large potatoes planted 1 foot apart.

With mangel-wurzels and turnips drills 26 inches apart proved better than drills 20 and 32 inches apart. With carrots the largest yield was obtained when drills were 20 inches apart.

Bokhara clover (*Melilotus alba*), mammoth red, alsike, Welsh, red and white clovers, and alfalfa were grown. *Melilotus alba* yielded at one cutting at the rate of 30.65 tons of green material per acre. The next largest yield, 13.33 tons, was made by mammoth red clover.—J. F. D.

Coöperative experiments with field crops in 1891, C. A. ZAVITZ (*Ontario Agl. College and Exptl. Farm, Report for 1891, pp. 193–199*).—The following experiments were conducted by farmers in 30 different counties of Ontario on 325 plats: Fertilizers for oats; nitrate of soda as a fertilizer for wheat; varieties of oats, barley, spring wheat, and peas; distance experiments with silage corn; and an experiment in growing alfalfa.—J. F. D.

Coöperative experiments with field crops in 1892, C. A. ZAVITZ (*Ontario Agl. College and Exptl. Farm, Report for 1892, pp. 283–300*).—Coöperative experiments were conducted by 754 ex-students of the Ontario Agricultural College and other farmers throughout Ontario. More than 5,000 plats were used for this work. The experiments embraced fertilizers for oats, nitrate of soda for rape, 3 varieties of millet, 5 varieties each of turnips, mangel-wurzels, and carrots, 6 varieties each of spring wheat, barley, and oats, and 4 of winter wheat, and an experiment in growing alfalfa.

Eighty pounds of nitrate of soda per acre was applied to a plat of rape growing on clay loam. The yield was at the rate of 20 tons per acre. The unfertilized plat yielded 18 tons.

In three coöperative tests and in the station test Salzer Dakota millet grew taller and gave a larger yield than Golden Wonder and common millet. The Manshury variety of barley gave an average yield of 10 bushels per acre more than the common Ontario six-rowed barley. The six-rowed varieties of barley all matured at an earlier date than the two-rowed varieties.—J. F. D.

Lawn grasses and fodder plants, J. FLETCHER (*Canada Exptl. Farms, Report for 1892, p. 164*).—Thirteen varieties of grasses were tested for lawn purposes during the summer. Of those found promising none exceeded in value the Kentucky blue grass (*Poa pratensis*). It forms the most compact sod and withstands the climate well. Some of the others by their varying color suggested possibilities in the way of ornamental grasses for lawns. Austrian brome grass was distributed for trial, but no report is given. Chess (*Bromus secalinus*) is considered a good grass for forage and makes a fair quality of hay. It is recommended as highly valuable for the Northwest, especially in alkaline soils.—W. H. E.

Comparative investigation of Russian and Danish barley, V. STEIN (*Ugeskr. f. Landmänd, 39 (1893), pp. 703–708*).—Seven samples of Russian barley imported from the Black Sea and three samples of Danish barley were examined for purity of seed and chemical composition. The average purity of the Danish barley was 98.60 per cent

(maximum 99.06 per cent, minimum 98 per cent), and of the Russian 96.81 per cent (maximum 98.01 per cent, minimum 95.33 per cent). The Danish barley contained 0.01, 0.01, and 0.22 per cent of weed seeds, and the Russian samples 0.83, 2.73, 1.20, 1.01, 0.94, 0.02, and 1.95 per cent, respectively. The chemical analysis showed the Russian barley to be richer in protein and poorer in starch than the Danish barley, while the latter contained more crude fiber and ash.

Calculating the valuation of the samples on the basis of a relative value of protein, fat, and nitrogen-free extract of 3, 3, 1, the "fodder units" for the Danish barley was 102.9 (range 102.2–103.9) and for the Russian barley 101.3 (range 98.6–102.8). According to the average market prices of the samples, the average cost of a "fodder unit" in the Danish barley was 5.3 öre (1.42 cents) and in the Russian barley 3.8 öre (1.02 cents).

In a later number of the *Ugeskrift* (*1893, p. 721*), feeding trials with Russian barley for horses are recommended. It is stated that barley is fed to horses with excellent results in northern Africa by the Berbers, and in the Orient by the Arabs.—F. W. W.

The growing and preparation of coffee for market, R. W. McCulloch (*Department of Agriculture, Brisbane* (*Queensland*), *Bul. No. 1, 2d ser., Sept., 1893, pp. 7–22*).—The two species of coffee mentioned as of special economical importance are *Coffea arabica* and *C. liberica*. The former has been the species mostly cultivated in southern India and Ceylon. The Liberian coffee plant is taller, hardier, and stronger, has larger leaves and berries, gives a heavier crop, and enjoys almost complete immunity from disease. It grows as high as 30 feet, and is better able to withstand dry weather than Arabian coffee. The Liberian coffee does not bear until 4 years old, while the Arabian bears at 2½ to 3 years. The former should not be pruned; for the latter, topping to a height of 4½ or 5 feet is recommended, with careful pruning of the young growth which has borne fruit.

Contrary to the usual opinion that coffee thrives only at elevations of 1,500 to 4,000 feet, with a temperature ranging from 55° to 80° F., the author makes the statement, based on experience, that both species of the coffee plant thrive anywhere in Queensland.

Among the requirements for coffee culture are a rich soil, deep and effective drainage, and shelter from wind. This latter is best attained by leaving strips of standing timber as wind-breaks when making the clearing for a coffee plantation. In preparing for a coffee plantation stumps and all timber should be removed, so that labor-saving implements may be used in the cultivation of the plants.

If *Coffea arabica* is to be grown, the seed should be procured from healthy, vigorous plants 7 to 10 years old, with strong branches closely jointed. The seed for planting should be fully ripe when gathered, unfermented, unwashed, dried in the shade, and still within the natural parchment covering. Old seed is useless. One bushel of seed affords

about 25,000 plants, sufficient to plant about 37 acres at distances of 8 by 8 feet with *Coffea arabica*, or about 80 acres with *Coffea liberica*, the plants of which are spaced 12 feet each way.

A closely planted nursery of half an acre will supply plants sufficient for transplanting on 100 acres. To shade the nursery a heavy coating of straw or grass may be used. Watering is necessary for plants in the nursery. When the plants have attained a height of 8 to 12 inches, or have developed one pair of primary branches, they are removed from the nursery, where the seed was planted about six months before. The transplanting should take place (in Queensland) at the commencement of the rainy season, that is, in the months of October and November. Each plant is removed from the nursery with an adhering ball of earth around its roots. After transplanting, a double handful of hay or grass is laid on the ground all around it, the purpose of this mulching being not to shade the plant but the earth around the roots.

The cultivation consists chiefly in the destruction of weeds, and is continued until the blooms appear. The coffee plant at its best yields in Ceylon and Java about 1,000 pounds of marketable coffee per acre and an average yield of 500 pounds per acre may be reasonably expected. It is estimated that it will require 14 men one day to pick 1 acre.

Hemileia vastatrix, a fungus leaf disease, has not been observed by the writer in Queensland. The means used for preparing the coffee berry for market are described and figured.—J. F. D.

The agricultural value of the hairy vetch (Vicia villosa), E. SCHRIBAUX (*Jour. Agr. Prat., 57 (1893), No. 34, pp. 252–256*).—The seed control station of the National Agricultural Institute of France sent out in 1892 a circular to farmers in different portions of France asking for their experience with hairy vetch. Twenty-four replies were received, twenty-one being favorable. These answers indicate that the hairy vetch is strongly resistant to heat and cold and that it has a high value as an early spring forage plant on light soils. In one case hairy vetch withstood a temperature of −26° C., when crimson clover was entirely destroyed. At Beaucourt, with an altitude of 450 meters, a cold spell lasting five days, with a temperature of −20° C., did not injure hairy vetch. In several instances it was proof against cold which wholly or partially killed winter vetch, crimson clover, and chick pea. Hairy vetch is considered by the author as able to resist the most severe winters in the coldest portions of France.

Its resistance to drought was shown on the station farm, which has a poor sandy soil. Here crimson clover grew only 2½ to 4 inches high and parched up; while hairy vetch seeded alongside and cut April 17 yielded 15,000 kg. of green forage per hectare. In spite of the drought the plants began to put out and yielded a good crop of seed. One grower reports that cuttings from March 25 to April 15 yielded 20,000 to 25,000 kg. of green forage per hectare; June 8, the second cutting

yielded 30,000 to 40,000 kg., or a total of 58,000 to 65,000 kg. for the two cuttings. Crimson clover grown as a check yielded 18,000 to 25,000 kg. per hectare.

Hairy vetch furnished green forage very early in the spring, and this was relished by horses and cattle. Hay made from it retained its green color and did not loose its leaves in handling. It was also used for silage with satisfactory results.

Hairy vetch succeeded even on impoverished soils where winter vetch would not grow; on calcareous soil the growth was not satisfactory, but for all soils except those which are calcareous or very wet the author considers it well adapted and ranks it among the best forage plants.

The second half of August is the best time for sowing in central and northern France. If a very large growth is made before winter it is well to mow it, taking care not to cut very close to the ground. To obtain a second cutting the first cutting must be made very early, about the time when the rye sown with it as a support is heading. Seed is saved from the second crop. Drilling is preferred to broadcasting, as this economizes the high priced seed. Seventy to 88 pounds of hairy vetch seed and 35 pounds of small grain are recommended as the proper quantities of seed for one acre.—J. F. D.

Testing the vitality of seeds, W. SAUNDERS (*Canada Exptl. Farms, Report for 1892, pp. 41, 42*).—A new building has been constructed devoted to seed testing and seed distribution. The partial results of the tests for the year 1891–'92 are as follows:

Germination tests of seeds.

Kind of seed.	Number of tests.	Highest per cent.	Lowest per cent.	Average per cent.
Wheat	442	100	0	85.7
Barley	284	100	19	85.0
Oats	431	100	25	93.3
Peas	67	100	8	90.4
Beans	42	100	60	84.8
Rye	11	93	46	78.0
Corn	17	100	0	73.3
Clover	4	88	63	76.0
Tares	4	97	76	85.5
Grass	6	44	0	18.6
Carrots	5	65	17	43.2
Turnips	3	75	18	55.6
Sugar beets	5	82	62	72.8
Cauliflower	3	60	19	42.3
Celery	3	0	0	0
Cabbage	9	95	26	57.3
Onion	4	60	0	39.2
Radish	4	85	35	59.5
Tomato	5	93	36	64.2
Pumpkin	2	62	60	61.0
Flower seeds	8	88	6	35.7

W. H. E.

Weeds, J. FLETCHER (*Canada Exptl. Farms, Report for 1892, pp. 147, 148*).—*Sisymbrium sinapistrum*, under the name of tumble weed, is becoming a serious pest in parts of the provinces. It occurs both in its annual and biennial forms. Its seeds are very small, and as single

plants have been known to produce more than 5 ounces of seed in a single season, it is capable of rapidly spreading. It is reported as most abundant in the wheat fields of the Northwest Territory.

Camelina sativa, *Neslia paniculata*, *Iva xanthiifolia*, *I. axillaris*, *Corydalis aurea*, *Cuscuta trifolii*, *Hieracium aurantiacum*, and *Lepidium campestre* have developed locally as very aggressive weeds.

Loco poisoning of sheep is reported from Manitoba, but no information is given regarding the specific plants owing to lack of material for determination.—W. H. E.

Treatment of fungus diseases, J. CRAIG (*Canada Exptl. Farms, Report for 1892, pp. 97–108*).—The following diseases were treated with fungicides with excellent results: Apple scab (*Fusicladium dendriticum*), gooseberry mildew (*Sphærotheca mors-uvæ*), grape mildew (*Peronospora viticola*), grape anthracnose (*Sphaceloma ampelinum*), spotting of plums (*Cladosporium carpophilum*), plum rot (*Monilia fructigena*), and anthracnose of bean (*Colletotrichium lindemuthianum*). The fungicides used were: Bordeaux mixture, ammoniacal copper carbonate, and potassium sulphide solutions. The bean anthracnose was treated by soaking the seed in solutions of ammoniacal copper carbonate or of copper sulphate. It was demonstrated that the disease could be easily and cheaply treated. The best results were secured by soaking the seed for one hour in the solution of ammoniacal copper carbonate. Where this is not available one half ounce of copper sulphate to 1 gallon of water is recommended. The percentage of germination is somewhat lowered by this treatment, but the quality of the crop is greatly increased. An experiment was conducted to test the value of adding lime to all fungicides and insecticides containing arsenites to prevent injury to the foliage by the latter. It was found in every case to be advantageous. Paris green may be used with ammoniacal copper carbonate if 1 pound of lime be added to 25 gallons of the solution.—W. H. E.

Potato blight (potato rot), J. FLETCHER (*Canada Exptl. Farms, Report for 1892, p. 161*).—A brief description of the disease, and preventive measures to be adopted for its treatment. The use of seed potatoes containing no evidence of dry rot is strongly urged. Bordeaux mixture is recommended as a spray and early and repeated applications advised. A joint experiment was begun by this station and the Vermont Station during the season, but was not wholly successful owing to severe drought. In the main the benefit of spraying was apparent. Untreated vines were dead at the beginning of September, while the leaves of some of the sprayed varieties were green when the crop was dug October 8.

Macrosporium solani was abundant on the unsprayed vines, and probably did more injury than the *Phytophthora*. Two varieties, Holborn Abundance and State of Maine, were conspicuous for their power of resisting all fungus attacks.—W. H. E.

Report of entomologist, J. FLETCHER (*Canada Exptl. Farms, Report for 1892, pp. 149–161, figs. 4*).—The hop-vine borer, or collar worm

(*Hydrœcia immanis*), has been reported from various places throughout the provinces, and in some localities it has become a serious pest. It is described as follows: "A small, slender caterpillar, about one half inch in length, marked with chocolate-brown bands of large irregular spots on a whitish ground, separated by a narrow white dorsal, a double lateral and an infrastigmatal, clear-white line. Head white, thoracic shield, anal shield, and the legs dark brown. They are found burrowing in the leading shoots of the hop early in June. Later the same caterpillars are found just beneath the surface of the ground, attacking the bases of the annual stems at the collar, where the vine springs from the rootstock. When full grown the larvæ are 1¼ to 1¾ inches long, of a dirty-white color, reddish brown heads, and the body spotted with black bristles bearing tubercles. The dark bands of the young larvæ are now almost wholly obliterated. The chrysalis is from 1 to 1¼ inches long, dark brown, elongated, with a double spine at the blunt posterior end. The moth measures from 1½ to 2¼ inches across the wings. The general color is a rosy brown, paler toward the extremities of the wings; the central portion is darker, being shaded with velvety bronze, and is marked with two large pale spots, one orbicular, the other reniform. The fore wings are divided into three areas by narrow, oblique, transverse lines, edged exteriorly with pale pink. The hind wings are paler in color, crossed in the middle by a slightly darker line. The sexes are similarly marked, but may be readily distinguished by the larger abdomen of the female and the conspicuous fan-shaped brush at the extremity of the abdomen of the male. The eggs are greenish white, rounded above, flattened below, and finally striate toward the base."

The eggs are laid singly on the shoots of the hop as soon as they appear above the ground, and the attack of the larva may be noticed by the time the shoot is 3 feet high. The larvæ eat into the vine, stopping its growth, causing what are called "bullheads" or "muffleheads," *i. e.*, the central stalk is destroyed, and from the node below two branches appear. The larva, when about one half inch long, abandons the aërial shoot and begins its work under ground, where it lessens the vitality of the whole plant.

Experiments have been attempted by various growers and are reported upon. Hilling up around the vines to produce a growth of secondary roots, and removing the soil from about the roots for a few days to harden them, have both been tried with some success. Hand picking may serve to prevent their ravages if the larvæ be destroyed from the young shoots. The effect of certain fertilizers, said to be beneficial, is to be given a more thorough test.

The red turnip beetle (*Entomoscelis adonidis*), a showy, scarlet beetle with three black lines down its back, a patch on its collar, and black legs, is reported as rather abundant and causing damage to the turnip crop.

When severe in its attack it may be checked by the use of arsenites. Where once abundant a crop of turnips should not immediately follow

an infected one, as the eggs are deposited in the ground ready for the next crop.

The western blister beetle (*Cantharis nuttallii*), a handsome beetle, an inch long, with plum-colored or green wing cases, glossed with gold, has been reported as unusually injurious to varieties of beans and allied leguminous plants. When not too abundant, collecting into vessels and destroying may be employed to prevent their ravages. When numerous over a considerable crop spraying with Paris green will destroy them.

The birch bucculatrix (*Bucculatrix canadensisella*) has been especially destructive to the varieties of *Betula alba* as well as the native species *B. papyrifera* and *B. lutea*. This insect is described in Insect Life, vol. V (E. S. R., vol. IV, p. 372). An allied species, *B. pomifoliella*, was abundant on apple trees during the past season at St. Catharines, Ontario.

A parasite of the eggs of the currant sawfly was discovered during the past season. It is a species of *Trichogramma*, as yet undetermined. Other species of this genus are parasitic on the imported willow sawfly and the tiger swallowtail. Other fungus and insect parasites of the oak looper, zebra caterpillar, and lesser grapevine sphinx are described.

Numerous other insects, more or less destructive to crops and trees, are reported upon.—W. H. E.

Analyses of Canadian grain fodders, F. T. SHUTT (*Canada Exptl. Farms, Report for 1892, pp. 115–121*).—Analyses are tabulated of ground oats, ground barley, ground wheat, frozen wheat, peas, Indian corn, rice meal, oat straw, barley straw, wheat straw, beans, English horse beans, sunflower stalks and leaves, and sunflower heads with eed.—E. W. A.

Experiments in feeding frozen wheat, S. A. BEDFORD and A. MACKAY (*Canada Exptl. Farms, Report for 1892, pp. 213, 214, 255*).—The experimental farm for Manitoba reports a trial of feeding frozen wheat to two-year-old steers. Lot 1 (2 steers) received 20 pounds of cut wheat straw and 16 pounds of No. 3 cracked frozen wheat (chop) per day; and lot 2 (2 steers) received 15 pounds of cut wheat straw, 10 pounds of No. 3 cracked frozen wheat, and 20 pounds of turnips. In a period of one hundred and thirty-two days lot 1 made a daily average gain of 1.3 pounds per steer, and lot 2, 1.7 pounds. With frozen wheat at one half cent a pound and turnips at 5 cents a bushel, and making no charge for the straw, the food of lot 1 cost $12.84 and that of lot 2 (turnips) $12.14. The steers cost 2¾ cents and sold at 4 cents per pound live weight.

"Although not the most economical way of feeding grain, chop-fed frozen wheat mixed with straw alone gave a return of 56 cents per bushel, not counting cost of labor.

"If turnips are added to the above ration, they not only pay their cost price but greatly increase the feeding value of the other ingredients."

At the experimental farm at Indian Head two large sows were fed exclusively on soaked frozen wheat for two months. They gained 172 pounds, which, with pork at 7 cents per pound, gave a value of 75 cents per bushel for the frozen wheat. Fed about one and one half months longer, during the fall, on frozen wheat moistened with water they gained 50 pounds, giving a value of 41¼ cents per bushel for the frozen wheat.—E. W. A.

Live stock experiments at the Ontario Agricultural College and Experimental Farm in 1891, T. SHAW and C. A. ZAVITZ (*Ontario Agl. College and Exptl. Farm, Report for 1891, pp. 106–133*).—This includes accounts of experiments on silage and roots for swine, feeding shorn and unshorn lambs in winter, fattening lambs for the British markets, and feeding grade steers of different breeds, previously described in Bulletins Nos. 64, 68, 69, and 70 of this institution (E. S. R., vol. III, pp. 133, 496, 741), together with previously unpublished work on the value of corn silage for beef production, feeding pigs on ground and unground grain, and feeding lambs on rape.

Corn silage for making beef (pp. 106–109).—This experiment was with six grade Shorthorn steers and lasted from December 11, 1890, to May 6, 1891. The steers were divided into three lots, all of which received 12 pounds of grain per head. Lot 1 received all the silage they would eat; lot 2 received 30 pounds of silage and all the hay they would eat; lot 3 received 45 pounds of sliced turnips and mangel-wurzels and all the hay they would eat. The grain consisted of equal parts of peas, barley, and oats, ground. Lot 1 gained 55 pounds; lot 2, 448.7 pounds, and lot 3, 537.7 pounds. Hence the most rapid gain was made by the lot on grain and silage. Valuing silage at $1.75 and hay at $5 per ton, and roots at 8 cents per bushel, the food for lot 1 cost $42.92; for lot 2, $41.45, and for lot 3, $51.75. This gave a good profit in the case of each lot, the largest being in the case of lot 1. Soon after the close of the experiment the steers in lot 1 were changed to silage, which was unusually sour. Both steers became sick and one died within a few days from general inflammation of the mucous membrane, stomach, and bowels. The five remaining steers were shipped to England for beef.

Feeding swine with grain and meal (pp. 122–125).—An experiment with three lots of 3 pigs each, averaging 104 pounds in weight per animal. Lot 1 received a mixture of two parts of peas and one part of ground barley, ground oats, and wheat middlings; lot 2, a mixture of equal parts of peas and barley ground; and lot 3, a mixture of equal parts of peas and barley unground. The trial lasted from May 7 to August 6—ninety-one days. Lot 1 gained 420 pounds; lot 2, 390 pounds; and lot 3, 333 pounds. The cost of food for the different lots followed the same order. The profit from the feeding was $10.29 with lot 1, $9.35 with lot 2, and $7.23 with lot 3. "This experiment demonstrates the advantage of feeding ground peas and barley over feeding the same unground to pigs of similar ages with those in this experiment."

Feeding lambs upon rape (pp. 131–133).—September 30, 45 lambs were turned into three acres of rape. They were divided into three lots. Lot 1 received rape alone with salt; lot 2 were given about one half pound of oats per head daily; and lot 3 were allowed to run in an adjoining pasture in addition to the rape. At the end of fifty-eight days, November 27, the gains in weight had been as follows: Lot 1, 1,413 pounds; lot 2, 1,413 pounds, and lot 3, 1,484 pounds. "It would, therefore, appear that the increase is considerably greater when the lambs have access to a pasture run than when confined to rape."

Six lambs were kept in a pasture of about one sixth of an acre of rape following carrots from September 30 to November 11, forty-two days, receiving no additional food. They made a total gain of 120 pounds. "At the above rate of consumption 1 acre of rape would have pastured 36.8 lambs for two months, and it would have made 762 pounds of mutton."

Sixty lambs placed in a field of 2.18 acres of rape for twenty-five days made an average daily gain of 0.26 pound.—E. W. A.

Live stock experiments at the Ontario Agricultural College in 1892, T. SHAW and C. A. ZAVITZ (*Ontario Agl. College and Exptl. Farm, Report for 1892, pp. 115–147*).—This includes experiments in feeding corn silage for beef, in fattening lambs, feeding lambs on different rations, and feeding shorn and unshorn lambs in winter, accounts of which were given in Bulletins Nos. 77, 78, 82, and 83 of the college (E. S. R., vol. IV, pp. 607, 610, 611), together with accounts of the experiments described below.

Feeding grade steers of different breeds (pp. 115–126).—This is a continuation of an experiment described in the Report for 1891, and in Bulletin No. 70 (E. S. R., vol. III, p. 741). Galloway, Aberdeen Poll, Hereford, Devon, Holstein, and scrub or native breeds were each represented by one animal, and the Shorthorn by two, one being fed skim milk. The trial commenced when the animals were most of them from one to two weeks old, and ended when they were two years old, with the exception of the native.

The present account is for the second year. The food consisted of hay, ground peas, ground oats, bran, turnips, mangel-wurzels, and green fodder (peas, oats, and corn).

At the end of the first year the financial results were much in favor of the Galloway, the Shorthorn following. At the end of the second year the figures show that only the Galloway and the Devon had made a profitable growth during the two years.

The steers were sold at from $3\frac{1}{4}$ (native) to 6 cents (Shorthorn) per pound live weight. All were slaughtered, and cuts are given of sections of the dressed beef from each.

The authors conclude that—

"(1) There is a marked difference in the constitutional ability of animals to bear a forcing ration, as witnessed in the behavior of the Gallo-

way grade, for instance, which made the highest daily gains during the second year of feeding.

"(2) In rearing animals for beef when fed a forcing ration for two years as in this experiment the meat will be made at a loss. In this experiment the extent of the loss was $68.96 on the eight animals with the value of the manure included.

"(3) The expense of rearing the native or scrub, including outlay and income, was more than that of rearing the average grade by $28.82, and more than that of the Shorthorn fed on skim milk by $32.28, while the total loss on the native or scrub for the two years was $34.27.

"(4) Stall-fed animals, though allowed daily exercise in a barnyard, will lose weight for a time when turned out on a grass pasture; and traveling by rail, though but for a short distance, followed by change of surroundings for but a short time, will seriously interfere with the gains of the animals."

Feeding rape to cows for milk production (pp. 130, 131).—In a comparison on four cows of feeding a grain mixture both with and without rape, "the heaviest yield of milk was obtained from rape and hay, and the second heaviest from rape without hay. The lowest yields were when no rape was given." About 20 pounds of green rape per cow was given daily.

Feeding calves on skim milk, skim milk and linseed meal, and whole milk (p. 131).—A brief mention of an experiment commenced with six grade Shorthorn calves. The experiment will be described subsequently.

Determination of the amount of manure voided by cattle (p. 131).—A record has been kept for two years of the manure voided by a young animal and this will be continued until the animal is at least 3 years old. The only data given is a recent analysis of the manure showing 53.51 per cent of water, 0.634 per cent of nitrogen, 0.829 per cent of phosphoric acid, and 1.494 per cent of potash.

Relative value for milk production of several varieties of clover hay and sunflowers (p. 132).—Six varieties of clover hay and three of sunflowers were fed to a milch cow. "While the results are interesting it is considered unsafe to present them to the public until repeated tests have been made. The sunflowers were eaten readily, but when fed in large quantities caused the cow to purge. The milk from the cow when fed sunflowers was of good flavor and possessed good keeping qualities."

Feeding rape to swine (pp. 146, 147).—Twelve pigs averaging 111 pounds each were fed, during the fall, in three lots, as follows:

Lot 1, rape and 12 pounds of grain, in pen.
Lot 2, rape and 12 pounds of grain, in field.
Lot 3, rape alone, in field.

"Much of the time that the animals were on rape the weather was very cold and blustery, and the rape was several times frozen. * * * Group 2 consumed 156 pounds more grain than group 1,

and made a live weight record of 25 pounds less. This difference must have been caused by the warm pen as against the cold weather and frozen rape, and not by the food given the two groups of animals, as this was the same in both cases. * * * The hogs ate the rape well, both in the pen and in the field."—E. W. A.

The effect of food on the quality and quantity of milk, H. H. DEAN (*Ontario Agl. College and Exptl. Farm, Report for 1891, pp. 154–173*).—Three lots of two cows each were fed the following rations in periods of about one month each:

Ration 1, 10 pounds cut hay, 30 pounds silage, and 20 pounds oat straw; nutritive ratio, 1:25.6; digestible crude fat, 0.41 pound.

Ration 2, 20 pounds cut hay, 2 pounds linseed meal, 2 pounds linseed cake, and 5 pounds cotton-seed meal; nutritive ratio, 1:3.9; digestible crude fat, 1 pound.

Ration 3, 20 pounds cut hay, 4 pounds pea meal, 5 pounds oat meal, and 8 pounds corn meal; nutritive ratio, 1:6.8; digestible crude fat, 1.05 pounds.

Ration 4, 6 pounds hay, 50 pounds silage, and 5 pounds bran; nutritive ratio, 1:8.4; digestible crude fat, 0.44 pound.

The milk was tested with the Babcock milk test. The conclusions as to effect of the food on quantity of milk were that—

"(1) Feed has a marked influence on the quantity of milk.

"(2) When cost of food is taken into consideration we find a great difference in the cost of producing 100 pounds of milk, and hence we should use those foods which give a good flow of milk at a comparatively low cost, and of the foods here given when the cost of production was lowest, silage formed the chief part of the ration.

"(3) The dry rations, though they contained much more digestible nutrients, did not increase the milk yield to any great extent. Succulent fodders containing sufficient nutrients appear to be better suited for a good milk flow.

"The food and the cow determine the quantity of milk, the cow governs the quality."

The following table shows the influence of the different rations on the yield and cost of milk with the 6 cows:

Average yield and cost of milk on different rations.

Rations.	Average yield of milk per week.	Cost of ration per day.
	Pounds.	*Cents.*
Winter ration (No. 4) (silage, bran, and hay) nutritive ratio, 1:8.4	1,252	12¾
No. 1 (silage, oat straw, and hay), nutritive ratio, 1:25.6	921	13¾
No. 2 (hay and oil meals), nutritive ratio, 1:3.9	1,227	24
No. 3 (hay, pea, oat, and corn meals), nutritive ratio, 1:6.8	1,353	33

As to the effect of food on the quality of milk and the source of fat, the conclusions were—

"(1) Lot 1 decreased in per cent of fat when changed to the poor ration, while the other lots gave richer milk and the average of all the

lots in regard to per cent of fat in the milk was greatest on No. 1; No. 2 next, and No. 3 last. The extreme variation, however, is so small (0.42 of 1 per cent) that we may say, so far as these experiments show, there was no appreciable difference in the per cent of fat given by the different lots, whether fed on poor or rich rations, but there was a marked difference in the total fat or butter yielded, due almost altogether to the quantity of milk given.

"(2) The average per cent of solids-not-fat from all the lots when fed on ration 1 was 7.79; on No. 2, 8.62; on No. 3, 8.37. The extreme variation is but 0.83 of 1 per cent from the different rations, hence we may conclude that these also remain quite constant. * * *

"In answer to the question, was the fat fed in the food recovered in the milk, these experiments show that on ration No. 1 more fat was recovered in the milk than was fed in the food, and on Nos. 2 and 3 the returns of fat in milk were about the same as the fat fed, but whether it all came from the fat of the food or not we are still in the dark."

In order to study the effect of food on butter the milk of each lot was set separately in deep cans on two days of each week, and the resulting cream ripened and churned. The treatment was as nearly uniform as possible in all cases. Samples of the butter were analyzed and determinations made of the melting point and iodine number of the fat. Unfortunately the samples produced on ration 3 were lost. The inferences from the tests of the others were as follows:

"(1) As indicated by the iodine number the butter from cotton-seed and linseed rations contained a high per cent of olein [40.6 to 44.6 per cent]. (In the case of the linseed, it may be partially accounted for by the high iodine number of linseed oil, 155).

"(2) Butter from the cotton-seed ration had a higher melting point than that obtained from any of the other rations used in the experiment.

"(3) So far as we could tell from a practical examination of the butter produced by the different rations, there did not appear to be much, if any, difference in them as to their merchantable value, especially for local markets.

"(4) The per cent of fat, water, and other foreign substance found in butter, is more likely due to the method of manufacture than to the influence of food."

To further study the effect of linseed meal and cotton-seed meal on milk, the same six cows were fed from June 7 to 28 as follows:

Lot 1, pasturage; nutritive ratio,* 1:7.1; crude fat,* 0.53 pound.

Lot 2, 30 pounds hay and 9 pounds linseed meal; nutritive ratio, 1:3.7; crude fat, 0.82 pound.

Lot 3, 30 pounds hay and 9 pounds cotton-seed meal; nutritive ratio, 1:3.3; crude fat, 1.09 pounds.

The cows on pasturage gave a larger yield of milk than those kept in the barn and fed on hay and grain. The conclusion as to quality of

*Estimated on the basis of 100 pounds of pasture grass per day.

milk is, as before, "that the food does not affect the quality of milk to any appreciable extent so long as the animals are in good condition. * * *

"An excess of fat and albuminoids did not give a corresponding increase in milk flow or in milk solids. In the case of lot 1 [pasturage] the fat of the milk was evidently obtained from something other than the fat of the food."

Accounts of further trials by the author in this direction are given in the Annual Report of the college and farm for 1892 and Bulletin No. 80 (E. S. R., vol. IV, p. 606).—E. W. A.

Report of poultry manager, A. G. GILBERT (*Canada Exptl. Farms, Report for 1892, pp. 168–176*).—This report consists of miscellaneous observations made on a number of different breeds of poultry, including the results of close confinement during the winter, the growth of chickens of different breeds, time at which the pullets commenced laying, the characteristics of the eggs of each breed (size and color), and remarks on the care of young chickens, together with some observations reprinted from the report of the previous year. The breeds tested were White Leghorns, Black Minorcas, Andalusians, Plymouth Rocks, Wyandottes, Houdans, Black Hamburgs, Langshans, Buff Cochins, Red Caps, Colored Dorkings, and Golden Polands. There were five or six hens and one cock of each breed. Each breed was kept in a pen, about 8 by 5 feet, by itself. The following extracts from this report are here given:

"Briefly stated, the observations noted were:

"(1) Six Black Minorca hens after laying well for some months were the first of 15 breeds to develop feather picking.

"(2) The replacing of the straw litter on the floor of the pens by earth had a good effect.

"(3) The earth on the board floor, occasionally raked over and renewed, kept remarkably clean for five months.

"(4) The most of the droppings were deposited during the night on the platforms under the roosts. These platforms were cleaned every morning and folded up against the partitions, so allowing more scratching room.

"(5) Keeping the pens scrupulously clean seemed to teach the fowls cleanly habits.

"(6) The earth when removed was a valuable manure.

"(7) Close confinement may be borne for a longer or shorter period, according as the essentials are supplied, but eventually ends disastrously.

"(8) The only remedy found was allowing the fowls outside range.

"(9) When it is impossible in winter to allow the fowls in shed, barn, or other scratching ground, put fewer in a pen."

The difference in the hatching of eggs produced at home and those brought some distance was observed.

"Some of the eggs procured from a distance hatched remarkable well. As instances may be mentioned, 26 Minorca eggs from Guelph and 13 Andalusian eggs from Toronto, the former giving 23 chicks and the latter 12. In another case, but later in the season, 15 of the farm eggs resulted in 14 chickens. On the other hand, 13 Buff Cochin eggs from the United States yielded only 4 chickens. As a rule, eggs which come from or go to a long distance do not give satisfactory results."

As to the growth of chickens, "the experience of the past five years shows that the Plymouth Rock cockerels make the most rapid growth of any breed so far tried. A cross of Brahma-Dorking during the past season grew quickly and attained large size, making 4 pounds in three months and fifteen days."

During the cold period, when the thermometer in the poultry building went down to 20° to 24° below freezing, "the Black Minorcas, Andalusians, Plymouth Rocks, Red Caps, and the White Leghorn-Brahma crosses laid the most eggs. This goes to strengthen the statement made in the report of last year 'that the breeds which are often stated to be the most unsuitable to cold climates do really lay the best.' But if eggs are wanted in winter the laying stock must be kept in a temperature where their combs will not freeze. Better still, if they can be kept where the water will not freeze."

The following ration for laying stock was fed to a flock of 293 fowls:

"*Morning warm ration.*—Five pounds shorts, 2½ pounds pea meal, 2 pounds corn meal, 2 pounds ground meat, 2 pounds oats with boiled vegetables occasionally mixed. At times fine ground oyster shells were added.

"*Afternoon ration.*—Twenty, 24, or 26 pounds of wheat.

"Vegetables, such as mangels, turnips, and carrots were regularly supplied."

Some observations on chicken roup are also reported.—E. W. A.

Effect of period of lactation on percentage of fat in the milk, H. H. DEAN (*Ontario Agl. College and Exptl. Farm, Report for 1891, p. 175*).—The milk of six cows of the college herd was tested for two hundred and seventy-four days. All the cows had been giving milk for about fifty days when the test began. Dividing the time into three periods of ninety-one days each, the results were as follows:

Percentage of fat in milk.

	First period (91 days).	Second period (91 days).	Third period (91 days).
Cow No—			
1	3.53	3.84	4.29
2	3.34	3.88	4.35
3	3.49	3.29	4.01
4	3.65	3.74	3.88
5	3.67	3.75	3.58
6	3.25	3.43	3.58
Average for six cows	3.49	3.66	3.95

"We do not find such an increased percentage of fat in the milk of these cows as is generally accredited to the influence of the period of lactation—an increase of only 0.17 per cent in the second period and 0.46 in the third over that of the first period."—E. W. A.

Effect on the ash of the milk of adding calcium phosphate to the food, J. NEUMANN (*Milch Ztg., 22 (1893), No. 43, pp. 701–704*).—The author reports two experiments on this subject. The first of these was of short duration (less than two weeks) and led to no definite conclusions; consequently the second experiment was made, which covered a period from August 22 to September 28. Three cows were used which had been from one to four months in milk. The food was the same as given the year round, namely, 22.5 kg. of fresh brewer's grains, 4 kg. of hay, 2 kg. of oat straw, and 20 grams of common salt per head daily. The first three days no calcium phosphate was added. After that 100 grams of calcium phosphate per head daily was added to the food. The results of the experiment are given in the following table:

Yield and composition of milk with and without calcium phosphate.

	Yield of milk.	Composition of milk.			In 1,000 grams of milk.		Composition of milk ash.	
		Total solids.	Fat.	Ash.	Lime.	Phosphoric acid.	Lime.	Phosphoric acid.
Without calcium phosphate:	*Kg.*	*Per ct.*	*Per ct.*	*Per ct.*	*Grams.*	*Grams.*	*Per cent.*	*Per cent.*
Aug. 22	27.16	11.65	2.81	0.77	1.4950	1.9271	19.42	25.03
23	27.40	11.68	3.01	0.77	1.4804	1.9594	19.23	25.45
24	28.20	11.52	2.80	0.77	1.4618	1.9930	18.98	25.88
With calcium phosphate:								
Aug. 27	24.85	11.90	3.05	0.75	1.4355	1.8865	19.14	25.15
31	25.79	11.66	3.02	0.75	1.4371	1.9307	19.16	25.74
Sept. 3	25.67	11.95	3.36	0.78	1.5566	1.9864	19.96	25.47
7	25.00	11.68	3.03	0.78	1.4995	1.9868	19.22	25.47
13	25.50				1.5252	1.9685	19.81	25.56
20	24.30	12.05	3.30	0.77	1.5916	2.0262	20.67	26.31
28	24.12	12.00	3.04	0.77	1.5509	2.1323	20.14	27.69

The average amount of lime and phosphoric acid in one 1 kg. of milk before and after adding phosphate of lime to the food was:

Lime and phosphoric acid in ash of 1,000 grams of milk.

	Lime.	Phosphoric acid.
	Grams.	*Grams.*
Without calcium phosphate	1.4791	1.9598
With calcium phosphate	1.5916	2.1323

In the opinion of the author there was an increase both in the percentage of phosphoric acid and lime in the milk ash, and in the absolute amount of these materials in a given quantity of milk, which was attributable to the calcium phosphate added to the food. The amount of phosphate of lime in the milk was smallest just after the commence-

ment of feeding phosphate of lime, but increased gradually, although the milk yield diminished slightly.

The author's conclusion is that the addition of calcium phosphate to a ration which already contains the requisite amount of ash constituents effects a slight increase in the calcium and phosphoric acid content of the milk. This increase is not apparent until the calcium phosphate feeding has been continued for three or four weeks, which may account for the negative results obtained by others in similar trials. He believes the production of milk with an especially high phosphate content ("phosphate milk") by feeding to be impossible.—E. W. A.

Effect of food on the content and character of the fat in the milk, JURETSCHKE (*Inaugural Dissertation, Leipsic; abs. in Molk. Ztg., 7 (1893), No. 38, pp. 518, 519*).—The author studied the effect on the milk of adding cocoanut cake, rape cake, and peanut cake to a basal ration in three separate periods of twenty days each. Two cows were used, one a pure bred East Friesian giving a large quantity of milk relatively poor in fat, and the other a pure bred Swiss whose milk was rich in fat. The basal ration consisted of hay, straw, brewer's grains, and wheat bran. From 2 to 2.5 kg. of the above oil cakes per 500 kg. live weight were added daily. The rations were in excess of Wolff's standard for milch cows. The decrease in yield of milk and in amount of fat produced due to advancing lactation was somewhat irregular in different periods, suggesting a possible beneficial effect of the cocoanut cake, although "a clearly defined effect of the cocoanut cake is not apparent."

To determine, if possible, whether there was a direct transmission of the fat of the food to the milk, determinations were made of the melting point, saponification equivalent, content of volatile fatty acids, and of insoluble fatty acids, etc., of the fats in the food and in the milk produced in each period. These data were not always uniform for the two cows, but they failed to confirm the view that the fat of the food is transmitted directly to the milk. For instance, the rape cake, which was the lowest in volatile fatty acids, gave milk fat with the lowest content of fatty acids; but this did not hold good for the other oil cakes, for the peanut cake, which contained considerably less fatty acids than cocoanut cake, gave milk fat with the highest content of these acids.

The conclusion arrived at from these trials is that the milk secretion is not directly, but only indirectly, affected by feeding, and that the feeding of large amounts of fat does not increase the yield of butter fat.—E. W. A.

Experimental dairy work, J. W. ROBERTSON (*Canada Exptl. Farms, Report for 1892, pp. 71-78*).—*Experiments in creaming milk* (pp. 71–74).—Comparisons were made of raising cream with an Alexandra separator, in shotgun cans in ice water, and in shallow pans. The herd consisted of Shorthorns, Ayrshires, Holsteins, Jerseys, Devons, and grades. For

one year, each of these methods was tested for a period of one week in every month. The milk set in cans or in shallow pans was skimmed after twenty-two hours. The percentage of fat in the skim milk ranged from 0.03 to 0.3 per cent with the separator, from 0.23 to 0.92 with deep setting, and from 0.4 to 0.72 with shallow setting. The percentage of fat in the buttermilk ranged from 0.07 to 0.04 where the separator was used, from 0.15 to 0.39 where the cream was raised in deep setting, and from 0.15 to 0.35 where it was raised in shallow setting. The amount of marketable butter obtained for 100 pounds of butter fat in the milk appears from the diagram given to have been considerably larger where the separator was used than where the cream was raised in either deep or shallow setting. As between the two latter methods of creaming the result was rather more favorable in the case of shallow setting. It should be remarked, however, that the temperature of the room in which the shallow pans were set was not above 60° except during June, July, and August.

Making butter from cows more or less advanced in the milking period (pp. 74–76).—Experiments were made in making butter from the milk of cows more than six and one half months advanced, and those less than six and one half months advanced in the milking period, raising the cream either by means of a separator or deep setting. The effect was also tried of using the milk of fresh cows with that of cows farther advanced in the milking period. With both methods of creaming the loss of butter fat was greatest with the milk of cows more than six and one half months in milk. "The butter from the cows which had been milking for the longer periods was not as good in flavor as that from the milk of cows which had been milking for the shorter periods."

"The addition of the milk of one fresh-calved cow to the milk from eight cows which had been milking for periods exceeding six and a half months each, resulted in the recovery of 18.55 per cent more of the butter fat than from the milk of the same cows when set in deep-setting milk pails, without the addition of the milk from a fresh-calved cow."

Churning sweet cream at different temperatures (p. 76).—Forty-two tests were made of churning sweet cream at temperatures ranging from 41° to 58° F. at the beginning of churning. The temperature at finishing was from 57° to 62°.

"The results from these forty-two tests indicate that—

"(1) When the churning of sweet cream is started at a temperature of 50° F. or under, the quantity of butter fat remaining in the buttermilk need not exceed 0.25 of 1 per cent.

"(2) For the efficient recovery of the butter fat by the churning of sweet cream, the temperature of the cream should not be above 50° F. when the churning is started; and the churn (if a revolving one) should not be filled to more than one quarter of its actual holding capacity."

Churning cream after the addition of different percentages of water (pp. 77, 78).—Four series of trials were made to compare the effects of adding different amounts of water to the cream before souring. The cream was raised by a centrifugal separator from the mixed milk of the herd. The cream in each of the four series of tests was divided into two equal portions, one being ripened to the usual degree of acidity, and the other portion diluted with from 10 to 30 per cent of water before ripening. Slightly less fat was recovered in the butter in churning where the cream was diluted with water, although the difference was but slight. The butter from the watered cream was not so solid or firm as the butter from the normal cream, but there was no appreciable difference in flavor. A longer time was required for churning watered cream, but no proportion was observed between the amount of water added and the time taken for churning.—E. W. A.

Experimental work in dairying in 1892, H. H. DEAN (*Ontario Agl. College and Exptl. Farm, Report for 1892, pp. 204–221*).—Experiments on the effect of food on milk and butter, on butter fat in milk and cream, and on butter-making on the farm in summer, previously reported in Bulletins Nos. 75, 76, and 80 of the college (E. S. R., vol. IV, pp. 606, 611), together with the following undescribed experiments.

Milking two and three times a day (pp. 209, 210).—Two of the best cows in the college herd were milked three times a day, at 5 and 11 a. m. and at 5 p. m., for two weeks. Their food, which had been 1 pound of bran and 2 pounds of ground barley, in addition to pasturage, was increased to 2 pounds each of cotton-seed meal, pea meal, and bran. At the conclusion of the first two weeks the cows were fed the same ration for two weeks longer receiving the of grain in two portions a day instead of in three portions, and were milked twice daily. The summarized results follow:

Results of milking twice and three times daily.

Period.		Total yield of milk in two weeks.		Average percentage of fat in milk.		Total fat yielded in two weeks.	
		No. 13.	Artis.	No. 13.	Artis.	No. 13.	Artis.
		Pounds.	*Pounds.*	*Per cent.*	*Per cent.*	*Pounds.*	*Pounds.*
1	Milked twice daily	531	819	3.50	2.93	18.59	24.00
2	Milked three times daily	549	710	3.87	3.03	20.27	20.80
3	Milked twice daily	489	607	3.55	2.76	17.06	17.87

"This experiment would seem to indicate that:

"(1) Frequent milking increases the per cent of fat, as both cows gave a higher percentage in their milk at noon and evening than in their morning milk. The average of these two and also of the three milkings per day was higher than their general average when milked twice a day. The effect on the total fat was to increase it in the case of one cow, while it remained about the same in the other.

"(2) One cow gave more milk when milked three times a day and the

other gave less, presuming that the extra meal balanced the failing pasture.

"(3) It would not pay to continue milking these cows three times a day for any length of time, as they seemed to regulate themselves to normal production in a short time. It might pay for a short time by keeping the cow at high pressure."

Gland milking vs. quarter milking (p. 210).—Two cows, seven and eight months in milk, respectively, were used for the trial. During two weeks previous to the trial Cherry gave 267 pounds of milk, containing 4.67 per cent, or 12.47 pounds, of fat; and during two weeks in which "gland" milking was practiced, *i. e.*, milking the two teats on each side together, she gave 266 pounds of milk, with 4.56 per cent, or 12.13 pounds, of fat. In two weeks previous to the trial Dairy Queen gave 250 pounds of milk, with 4.62 per cent, or 11.55 pounds, of fat; and in two weeks of gland milking she gave 228 pounds of milk, with 4.07 per cent, or 9.27 pounds, of fat.

Testing milk and cream (pp. 211–219).—A description of composite sampling and the method of using it in paying for milk at factories.

Creaming milk (pp. 219, 220).—The results of a number of trials indicated the temperature for deep-setting to be 45° F. or lower. In ten trials the skim milk contained 0.07 per cent more fat when the setting was delayed some time than when not delayed. Milk cooled to 45° and then set at 40°, gave skim milk with 0.42 per cent of fat as the average of six trials.

The skim milk from milk heated to 93° to 110° before setting contained practically the same percentage of fat as where the milk was not heated. In ten trials the addition of 10 to 25 per cent of water between 118° and 160° appeared to very slightly improve the thoroughness of creaming.

Aërating milk for butter-making (p. 220).—Four lots of milk from the college herd were divided, one half being aërated and the other half set without aërating. Butter was made from each lot under similar conditions. After keeping about two months "there was no difference in the quality of the butter so far as we could tell."

Sweet vs. ripened cream (p. 221).—Four comparative trials are reported in making butter from sweet and from ripened cream. In each case more fat was lost in churning the sweet cream and a longer time was required. After keeping three or four weeks the sweet-cream butter was reported off flavor and of inferior quality to the ripened-cream butter.—E. W. A.

Miscellaneous dairy work, H. H. DEAN (*Ontario Agl. College and Exptl. Farm, Report for 1891, pp. 181–186*).—*Delayed setting of milk* (pp. 181, 182).—The results of nine comparative trials, in which the milk was set immediately and after starting an hour, indicated that "as far as loss of fat in the skim milk is concerned, there would not appear to be much difference whether the milk be set at once or delayed, so long as it is cooled to about 40° F. before it is skimmed."

Fat in samples of milk taken at different stages during milking (p. 185).—Samples of the milk of a grade Shorthorn cow, about six months in milk, were taken at three or four different times during milking on six occasions.

"While, as a rule, the last samples are much richer than the first, there appear to be some exceptions. In the case of No. 1 the fourth sample is only 1.8 per cent richer than the first, and in the case of No. 5, the first sample was richer than the second."

Amount of land required to soil a cow (p. 186).—About seven tenths of an acre of soiling crops (green clover, green peas, tares, oats, and corn fodder) was sufficient, with the addition of 252 pounds of wheat bran, for two cows for sixty-three days. "We might expect, therefore, to grow on about one acre sufficient green food to feed a cow for two hundred days under ordinary conditions"—E. W. A.

The discrimination between abnormal and adulterated milk, H. D. RICHMOND (*Analyst, 18* (*1893*), *Nov., pp. 270–279*).—The principal means pointed out for distinguishing between abnormally poor milk and adulterated milk, are the relative number of large fat globules; the relation between the fat and the solids-not-fat; the removal of the fat, increasing the proportion of solids-not-fat; the proportion of ash in the solids-not-fat, which are stated as commonly varying from 8 to 8.5 and averaging 8.3 per cent; the proportion of milk sugar and proteids; and the diphenylamin test for nitric acid. In the latter test milk serum is used, and the presence of a reaction is taken as an indication that water containing a trace of nitrates has been added to the milk.

In the discussion following the paper exceptions were taken to nearly all the means suggested, especially to the nitrate test. It was urged that London water, containing only a mere trace of nitrates, might be used for the adulteration, and that normal milk might contain nitrates under exceptional conditions.

In a supplementary note added since the reading of his paper, the author reports a trial of giving one gram of potassium nitrate per day to three cows for three days. "Eight hours after the last dose of potassium nitrate was administered, the cows were milked, and the milk gave a strong reaction for nitric acid; twenty hours after the last dose the cows were again milked and the reaction for nitric acid, though not so strong, was quite distinct. As I have on several occasions found on farms waters containing from 10 to 15 parts per 100,000 of nitric acid, a quantity equal to one gram of potassium nitrate might easily be absorbed daily by the cattle." These observations, he concludes, defeat the nitrate test.—E. W. A.

Determination of specific gravity of sour milk, M. WEIBULL (*Chem. Ztg., 17* (*1893*), *No. 91, p. 1670*).—The clabbered milk is shaken with a definite volume of ammonia, usually about one tenth of the volume of the milk, and the specific gravity taken as usual, correcting the reading for the ammonia added. Experiments have shown that no con-

centration takes place by mixing the milk and ammonia, or at least not sufficient to affect the reading. The results of comparative determinations on fresh milk and on sour milk treated with ammonia showed practically no difference in the corrected readings, 0.0003 being the largest difference.—E. W. A.

The Babcock method for estimating butter fat in milk (*Canada Exptl. Farm, Report for 1892, pp. 135–137*).—It is proposed to test milk by the Babcock method by means of composite weekly samples, the sample taken each day to represent one sixth of the amount of fat usually taken for the Babcock test. These combined samples are tested at the end of six days, and experience indicates that curdling and souring of the milk in the test bottle previous to the testing does not affect the accuracy of the result. A pipette delivering 2.93 c. c. of milk is necessary for testing with this method.

Trials are also reported of preserving the composite samples with potassium bichromate. The results are shown in the following table:

Fat in composite milk samples.

Composite sample (six days).	Bichromate and Babcock test.	Average of daily analyses by gravimetric method.
	Per cent.	*Per cent.*
Sample A	3.70	3.625
Sample B	3.55	3.505
Sample C	4.85	4.830

"The above represents the results of a three weeks' trial, but subsequent work has confirmed the great accuracy here depicted.

"The treated milk is perfectly fluid at the end of five weeks, and allows of a perfect sample being then taken. * * *

"Commercial potassium bichromate is quoted at 14 cents per pound. This is sufficient for about 1,000 composite samples. By its use the testing of the milk is only necessary once a week, thereby saving a large expenditure of time and labor over the method now in vogue.

"In working this method, I would advise the taking of the milk sample from the weigh can by means of a tube, open at both ends, of about one eighth of an inch in diameter. The tube is placed in the can, the upper end closed with the finger and withdrawn. The contained milk is then allowed to run into the patron's sample bottle. In this way not only is a thoroughly representative sample obtained, but a proportionate amount of the milk daily supplied by each patron is secured."—E. W. A.

On some modifications in the Babcock machine, C. R. C. TICHBORNE (*Analyst, 18 (1893), Oct., pp. 237–240*).—The modification consists in making the lid double walled with about an inch between the walls. This space is filled with about a pint of boiling water poured in through a little funnel at the apex of the lid. The advantages

claimed for the heated lid are that it maintains a uniform temperature during the test, prevents the solidification of any of the fat in the stems of the bottles, and makes the separation more rapid, "the operation being perfectly complete in two terms of five minutes' duration each." The modified machine has been patented. The author finds it necessary to correct the results given by the Babcock test according to the percentage of fat, but does not approve of using a constant correction for all cases, as suggested by Embrey.*—E. W. A.

The use of pasteurized and sterilized cream in butter-making, POPP and BECKER (*Hyg. Rundsch. 3, pp. 530–534; abs. in Chem. Centbl., 1893, II, No. 16, pp. 768, 769*).—The author found in whole milk 72,954 germs per cubic centimeter. The germ content after running this milk through a separator was: Cream 58,275 germs, skim milk 21,735 germs, and the separator sediment 43,891 germs per cubic centimeter. Portions of the skim milk and cream were pasteurized and others sterilized. The pasteurized skim milk contained 1,070 germs and the pasteurized cream contained 1,170 germs per cubic centimeter, while the sterilized skim milk and cream were germ free.

The pasteurized, sterilized, and unsterilized cream was churned with the greatest care to prevent contamination from without. The butter from unsterilized cream contained 49,581 germs per cubic centimeter, was normal in taste, and somewhat sour; that from pasteurized cream contained 17,630 germs per cubic centimeter, was slightly lardy, and less sour than the preceding; and that from sterilized cream contained 7,497 germs per cubic centimeter was strongly lardy, and not sour. The butter from pasteurized and sterilized cream had a slight cooked taste at first, which disappeared in a few days.

In later experiments the authors found that butter from pasteurized and sterilized cream kept much longer than that from unsterilized cream, that from sterilized cream keeping the longest. The authors recommend sterilizing the materials in butter-making.—E. W. A.

Sweet cream butter, H. H. DEAN (*Ontario Agl. College and Exptl. Farm, Report for 1891, pp. 179–181*).—Ten experiments are reported in making butter from sweet cream during October and November. The loss of fat in the buttermilk was excessive when the temperature of churning was above 52° or 54° F. "If a higher temperature than this is used, from three quarters to one and a quarter pounds of butter may be expected to be left in every 100 pounds of the buttermilk." At this temperature the average time required for churning in eight trials was an hour and twenty-six minutes. At 62° the butter came in about one half hour, but the buttermilk contained, on an average, 1.5 per cent of fat.

The first few days after making there was little difference in flavor between butter from sweet cream and from ripened cream, but after a week the sweet-cream butter showed signs of spoiling.—E. W. A.

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* Analyst 18 (1893), May, p. 118.

TITLES OF ARTICLES IN RECENT FOREIGN PUBLICATIONS.

CHEMISTRY.

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die Thätigkeit der landwirthschaftlichen Versuchstationen Preussens im Jahre 1892), K. Rümker.—*Landw. Jahrb.*, *22* (*1893*), *sup. III*, *p. 244*.

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EXPERIMENT STATION NOTES.

INDIANA.—Purdue University sustained a severe loss on January 23, when the new engineering laboratory was burned, only four days after its dedication. The fire originated in the boiler room and spread so rapidly that only the wood room and foundry could be saved. The machine shop with its entire equipment, the forge room, containing thirty-two power forges, and the laboratory for advanced work, with much scientific apparatus, were completely destroyed. The main portion of the building, 50 by 150 feet, three stories high, and containing drawing, recitation, and lecture rooms, offices, instrument rooms, and a mechanical museum, were also burned, though some of the furniture and apparatus were saved.

The building cost $100,000 and the machinery $80,000; the insurance was $45,500. Not an inconsiderable feature of the loss is the destruction of books, papers, and data belonging to members of the faculty, instruments owned by the students, and machinery and apparatus loaned by manufacturers.

The work of the university will not be interrupted, and it is hoped and expected by those in charge that a new building as good as the one burned will soon be in process of construction.

KENTUCKY STATION.—The large barn on the station farm was burned December 23, with all its contents. The crops of the year and all the tools, implements, etc., belonging to the station were burned, together with 8 head of live stock and 53 boxes of exhibits from the World's Fair, presented by the State to the station. The value of the barn was $4,000, insured for $3,000. There was no insurance on the contents.

MICHIGAN COLLEGE.—A six weeks' course in practical dairy husbandry will be given at this institution during January and February. The work will be under the immediate supervision of Prof. C. D. Smith, and the instruction will be divided into five subcourses: (1) Dairy practice in butter-making, (2) dairy chemistry, (3) breeding, selecting, and feeding dairy stock, (4) judging and scoring butter, and (5) study of dairy literature.

NEBRASKA STATION.—Dr. A. T. Peters, of Chicago, is to begin work at the station as veterinarian or investigator of animal diseases February 1, 1894.

WASHINGTON STATION.—Much interest is being manifested in this State, particularly in the "Palouse country," in which the station is located, in the adaptability of Washington climate and soil to the successful culture of sugar beets. Some inconclusive work has already been done by boards of trade. The chemical division of the station is making preparations for systematic work in this direction. It is proposed to enlist the aid of farmers in every county and so make the work something more than local. Seed will be distributed, with printed instructions for culture, and it is hoped that the trials of the coming season will furnish considerable reliable data on the subject. At present the chemical division is engaged in the analysis of typical soils from various portions of the State, and will issue a bulletin on the work about February 15.

The station entomologist is studying the tomato blight.

During the season just past the division of agriculture has made a large number of variety tests, the results of which are soon to be published. A test in feeding swine is now being conducted, using wheat and barley as foods.

AMERICAN FORESTRY ASSOCIATION.—The annual meeting of this association was held at Washington at the Department of Agriculture, December 15, 1893. The meeting was mainly of a business character, devoted principally to the election of officers for the ensuing year and to considering measures for the promotion of the objects of the association, especially the protection of the public forests which have recently been set apart in reservations by Presidential proclamations, under the act of Congress of 1891. No important papers were read at this meeting, the great number of such papers read at the special meeting at Chicago in October having left a great amount of material on hand awaiting publication and distribution. The executive committee of the association is now considering the most feasible method of laying these papers before the public.

The officers of last year were reëlected for the most part, a few changes being made among the vice-presidents, one of whom is appointed for each State and Territory. Hon. J. Sterling Morton, Secretary of Agriculture, was chosen president; J. D. W. French, of Boston, corresponding secretary; N. H. Egleston, of Washington, recording secretary; and Dr. A. M. Fisher, of Philadelphia, treasurer.

It is expected that the association will hold a special meeting at Albany in the course of the winter, the principal object of which will be to give its support to the movement which is now making to preserve the great Adirondack forest from destruction, by securing its possession by the State of New York as a great public forest park.

The members of the association expressed their hearty approval of the bill known as the McCray bill for the management and protection of the public forest reservations which have been made during the last two years, and which now amount to 13,000,000 acres in extent.

MINNESOTA BOTANICAL STUDIES.—*Geological and Natural History Survey of Minnesota, Bul. No. 9,* contains the following articles: On the occurrence of sphagnum atolls in central Minnesota, Conway MacMillan, pp. 2–13; Some extensions of plant ranges, E. P. Sheldon, pp. 14–18; On the nomenclature of some North American species of *Astragalus,* E. P. Sheldon, pp. 19–24; List of fresh-water algæ collected in Minnesota during 1893, J. E. Tilden, pp. 25–31; On the poisonous influence of *Cypripedium spectabile* and *C. pubescens,* D. T. McDougal, pp. 32–36.

The following new species are described by Mr. Sheldon: *Polygonum ridulum, Aster longulus, Astragalus elatiocarpus,* and *A. scorbinatulus.*

Mr. McDougal concludes that the poisonous influence of the *Cypripediums* is localized in the abundant hairs with which the plant is covered. Two forms are noted, one curved and septate, ending in a sharp point, the other a glandular, septate hair. Both are acid in their reaction.

SUGAR MAPLES AND MAPLES IN WINTER.—In the *Fifth Annual Report of Missouri Botanic Gardens,* William Trelease revises the species of sugar maple and recognizes in the *Saccharum* group the following species and varieties; *Acer saccharum, A. saccharum nigrum, A. saccharum barbatum, A. floridanum, A. floridanum acuminatum,* and *A. grandidentatum.* A synoptical key and descriptions based on the winter conditions of all the North American species of *Acer* are given.

SECONDARY EFFECT OF FOREIGN POLLEN.—C. W. H. Heidemann, of New Ulm, Minnesota, gives in a brief report the results of two years' experiments in crossing and hybridizing plums, and thinks that it is conclusively shown that the effect of foreign pollen increases or decreases productiveness, and within certain limits influences the size and quality of the fruit. The following experiments are cited:

The Wolf plum possesses many qualities to make it desirable for use as one of the parents of a future improved race of plums. Last season about 100 blossoms of the Wolf were pollinated with 6 other varieties. Those pollinated with the pollen of

Hiawatha soon showed the beneficial effects of the cross and were far superior in size and quality to all the rest. Hiawatha is a pure *Prunus americana*, but it comes so near being sterile that, although blooming abundantly, 99 per cent of the blooms are without pistils, and on that account it is of no value except for experimental purposes.

From ten blossoms pollinated with pollen of Hammer, a probable hybrid between *P. americana* and *P. hortulana*, the fruit differed slightly in shape, but was otherwise very fine and equal to the first cross. Ten blossoms pollinated with the pollen of New Ulm developed normal fruits rather inferior to the self-fertilized Wolf. Ten blossoms pollinated with pollen of a supposed new species indigenous to Minnesota developed very small fruits and changed the fruit from nearly freestone to a perfect cling. Ten blossoms pollinated with the pollen of Early Red set no fruit. Ten blossoms pollinated with the pollen of Carolina developed fruits much inferior to those of the self-pollinated Wolf. As a check 10 blossoms were self-pollinated, and they developed fair fruits, inferior to those fertilized by Hiawatha and Hammer, but superior to the other crosses.

Again a chance seedling was planted almost under the top of a tall Weaver plum. For several years the fruit was a large flattish oblong freestone of good quality and very productive. This plum being so much better in quality than the Weaver, the Weaver tree was cut down, and ever since the fruit has been smaller, nearly round, and a perfect clingstone. Last spring pollen from Weaver was applied to a few blossoms and the fruits clearly showed the effect of the foreign pollen.

The effect may sometimes be observed only in the seeds. Last year, while opening some hips of a native wild rose which had been hybridized with various hybrid Remontant roses, several seeds were noticed of different color and shape from the others in the same hip. The seeds were planted separately and produced seedlings which can scarcely be distinguished from Remontants, and as yet show no hybrid character.

The author concludes "that between slightly differentiated individuals of the same species there is an immediate secondary effect of foreign pollen."

The Carbohydrates of the fruit of the Kentucky coffee-nut tree (Gymnocladus canadensis).—Investigations on the pulp or gum of the seed pods of this plant reported by W. E. Stone and W. H. Test in *Amer. Chem. Jour.* (*vol. 15, No. 8, pp. 660–663*) show that "sucrose and glucose are both present in large quantities, while the insoluble portion contains bodies or a body which on inversion yields a pentose and glucose, to which the name of gluco-araban may be provisionally applied."

International Congress of Applied Chemistry.—An International Congress of Applied Chemistry will be held in Brussels, beginning August 4, 1894, and lasting a week. The congress will be divided into four sections, *i. e.*, sugar industries, agricultural chemistry, food products and public health, and chemical biology. According to Chemical News, "it is proposed to start eventually a 'Review of Reviews of Applied Biological Chemistry,' published in several languages, and containing a résumé of chemical work of this description from all parts of the world." Further information as to the congress can be obtained from the general secretary, M. Sachs, 68, Rue d'Allemagne, Brussels.

Great Britain.—From a preliminary statement of the estimated production of wheat, barley, and oats in Great Britain, it appears that the total production of wheat and barley has decreased between one seventh and one eighth from that of 1892. This is due largely to a decreased acreage, although there was also a decreased yield per acre, except in Scotland. Oats show but a slight decrease, due entirely to decreased yield, as there was a larger acreage in 1893.

On night frosts and the means of preventing their ravages.—This is the title of a pamphlet of 78 folio pages, by Selim Lemström, printed in English and forming No. 3 of vol. XX of *Acta Societatis scientiarum fennicæ*. The fact that Finland suffers several times in every century from disastrous frosts during the grow-

ing season, followed by famine, led the author to study the nature and causes of this phenomenon, with a view to discovering means of protection against it. In this work he was aided by a small appropriation from the Finnish Government (2,000 francs or $380). The study of the nature and causes of frosts led to the conclusion that they could be prevented either by the production of artificial clouds or by creating currents in the air or by both means combined, and resulted in the development of two methods of prevention based upon these principles. In each method frost torches of special construction are used. These frost torches consist of tubes of well-dried peaty mud and kindling cylinders which can be inserted into the tubes.

The tubes are molded by machinery and are 20 cm. (5 inches) long and 13 cm. ($3\frac{1}{4}$ inches) in diameter, with an opening of 4.5 to 4.7 cm. ($1\frac{1}{8}$ to $1\frac{1}{6}$ inches). "If they are well dried they may be placed in the field which is to be protected and remain there all the time frost may be expected or until they are used, for the rain affects only their surface and they dry very soon.

"The diameter of the kindling cylinder is 4.5 cm. ($1\frac{1}{8}$ inches), its height 3 cm. ($\frac{3}{4}$ inch), with an opening of 1 cm. ($\frac{2}{5}$ inch). When moistened with a little petroleum the kindling cylinder is put a little more than its length into the sloping mud tube and kindled. At first it burns with flame, but begins soon to produce so much heat that the mud tube begins to carbonize. The torch thus constructed can be manufactured at a price of 3 or 4 centimes (0.6 to 0.8 cent), and possesses in a high degree all the [desired] qualities."

First method.—"The field which is to be sheltered must be carefully examined, to discover if a current of cold air from some bog land, situated on a higher level in the neighborhood, is to be expected. This current must be cut off by means of torches placed not more than 2 meters apart.

"If the field lies in the open, in meadow or bog lands, the torches must be placed all round the field 3 meters apart (5 steps), and along the borders of ditches at a distance of 15 meters from each other (25 steps)."

The numbers of torches required for different areas are as follows: "For 10 hectares (24.7 acres) 1,100 torches; for 5 hectares, 600 to 650; for 4 hectares, 500 to 550; for 3 hectares, 400 to 450; for 2 hectares, 270 to 320; for 1 hectare, 160 to 210; and for 0.5 hectare, 100 to 150." A number of torches must always be held in reserve for special currents of cold air.

"If the field in question is surrounded by forest or hills so that no open fields lie between, the number of torches can be diminished by 10 to 20 per cent, and this may also be done when the field lies on a slope and is well drained with open ditches.

"The torches should be lighted shortly after sunset during the months of June and July, but in May, August, and the beginning of September, they need not be lighted till after midnight, unless the temperature has fallen below 0 earlier."

This method has proved very effective in numerous trials. Assuming that these protective measures must be taken 4 times in ten years in Finland, the average cost for that period is estimated at $6.80 per $1,000 worth of crop annually. The cost will be somewhat greater on smaller areas, "but if home-made the torches will be cheaper, so that in this case the cost need not be greater than the above calculation."

Second method.—The second method, depending upon the use of these torches to create currents of air and thus to raise the temperature of the layer of air near the surface of the soil, has not been tested, but in view of various theoretical considerations, which are discussed, it appears to be a promising means of protection.

"It is clear that if this method proves successful, the cost of protection is brought down to a point which makes insurance against damage by frost possible. The protection against frost should lie in this case on the insurance company."

Some such system of insurance seems to be necessary, since in the experience of those who have investigated the subject during the last ten years it appears evident

that the farmer can not be relied on to take the necessary protective measures himself.

Forecasts of night frosts.—"It is, of course, of the greatest importance to interpret correctly the warning signs given by nature before a frosty night, so that the preventive measures are not needlessly precipitated. A night frost never comes unawares, and its forewarnings are fortunately sure and easily interpreted, especially those of the general, extensive frosts."

From extensive observations on the subject the author lays down the following rules regarding the forecasting of frosts:

The danger of frost is great if a calm comes on after clear cold days having a low temperature.

"The danger is greater in proportion to the dryness of the air, and greatest if the dew-point is below zero.

"The probability of frosts can be judged from the color of the sky after sunset; the more the blue tone predominates the greater is the danger; if the color tends more towards gray the danger is less.

"If even a very slight motion in the air continues to within an hour or an hour and a half before sunrise no damage by frost need be feared."

M. VILLE'S VIEWS ON AGRICULTURE.—*Chemical News* (*68, Nos. 1772 and 1773*) reviews some of the recent publications of M. Georges Ville, of France. He recommends green manuring or "sideration," as he calls it, using for that purpose leguminous plants which collect nitrogen from the air. "Where there is at hand a good market for dairy products, meat, or wool, he upholds live stock as remunerative. 'But how,' he asks, 'can any number of cattle supply manure to keep the pastures fertile and at the same time supply manure for the cultivated land?' He seeks to convince the farmer that to keep cattle as producers of manure is a capital error. Such manure, if carefully valued, is found to cost more than its actual worth and much more than the cost of an artificial manure of equal or superior value. Farmyard manure is found to contain only 1.48 per cent of plant food; it has the defect that its composition can not be varied according to the requirements of any particular crop. Further, if a pasture land is poor in phosphates, the excreta of cattle fed upon it can not be rich in phosphates, and will be very ill adapted as a fertilizer for any crop which is in need of phosphoric acid. In one of his works (*La Betterave et la legislation des Sucres*) M. Ville cautions his readers against the use of the Stassfurt potash salts. He contends that night soil, at least if applied to the sugar beet, yields very heavy crops, but at the expense of the quality of the roots, which are hollow and poor in sugar. He places the sources of nitrogen in the following ascending series as regards their efficiency: Organic nitrogen, ammonium sulphate, sodium nitrate, and potassium nitrate.

"He insists on the maintenance of a due equilibrium among the constituents of plant food; if any one of these ingredients is in excess, the surplus contributes neither to the quantity nor to the quality of the crop, but remains in the soil without being taken up by the plants and is consequently wasted as far as the farmer's returns are concerned. M. Ville's conclusions agree in the main with those of the leading agricultural chemists in this country; but there is one important difference. He classes lime as one of the four constituents with which soils—without distinction of their character—are not provided by nature to an extent sufficient for the growth of the plants. Hence it figures in all his formulas in the state of calcium sulphate, gypsum. Now, in England, experience has shown that—except for certain special crops, such as clover—gypsum is of no appreciable value. Hence plants have been divided into calciphilous and calcifugous. The former grow by preference naturally in calcareous earth and when growing in ordinary average soils are distinctly benefited by dressings of lime or of manures containing lime. The calcifugous plants, on the contrary, may be exterminated by the application of lime. If we consider that the proportion of calcareous matter in the soils capable of cultiva-

tion may exceed 30 per cent, we may be surprised when told that lime is universally necessary, as are nitrogenous matter, phosphoric acid, and potash."

Laboratory for the German Agricultural Society.—The German Agricultural Society has established an agricultural chemical laboratory in Berlin. The object of this laboratory is to perform the chemical work in connection with the scientific experiments and undertakings of the society. The laboratory is in charge of Dr. J. H. Vogel, the agricultural chemist of the society, with Dr. Häfke, of Berlin, as assistant.

Personal mention.—Dr. Joseph Boehm, professor of botany in the University and in the High School for Soil Culture in Vienna, died December 2, in his sixty-third year.

Dr. Theodore Cooke has been chosen as scientific director of the Imperial Institute of India.

F. Matouschek has been appointed assistant in the Botanical Institute in the Royal University of Prague.

Paul Giraud of Saint-Barnabé (Marseilles), an eminent French horticulturist, died recently. He devoted much of his life to the improvement of fruit culture. Upon the appearance of the phylloxera he was one of the first to use bisulphide of carbon as a remedy. His recent work has been on the varieties of American vines, one of which bears his name.

Recent articles by station workers.—*Botanical Gazette* (*vol. XVIII*), The bacterial flora of the Atlantic Ocean in the vicinity of Woods Holl, H. L. Russell, pp. 439–447; Studies in the biology of *Uredineæ*, M. A. Carleton, pp. 447–457.

Garden and Forest (*vol. VII*), Spraying apple orchards, E. G. Lodeman, pp. 25, 26; Forcing houses in dark climates and damping off, L. H. Bailey, pp. 26, 27.

Torrey Bulletin (*vol. XX*), The Solandi process of sun printing, B. D. Halsted, pp. 485–488; Heliotropism of the common mallow, B. D. Halsted, pp. 489, 490.

American Florist (*vol. VIII*), The brown or soft orange scale (*Lecanium hesperidum*) on roses, F. M. Webster, p. 674.

Agricultural Science (*vol. VII*), The aim and methods of investigations in stock feeding, H. P. Armsby, pp. 481–492; Broom sedge, sedge grass (*Andropogon virginicus*), H. J. Patterson, pp. 493, 494.

LIST OF PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE.

JANUARY, 1894.

Farmers' Bulletin No. 13.—Cranberry Culture.

WEATHER BUREAU:

Monthly Weather Review, October, 1893.

Monthly Weather Review, November, 1893.

Report of the Chief of the Weather Bureau for 1891–'92.

BUREAU OF ANIMAL INDUSTRY:

Bulletin No. 4.—A revision of the Adult Cestodes of Cattle, Sheep, and Allied Animals.

Bulletin No. 5.—Report on the Dairy Industry of Denmark.

OFFICE OF EXPERIMENT STATIONS:

Experiment Station Record, vol. v, No. 2.

Experiment Station Record, vol. v, No. 3.

Experiment Station Record, vol. v, No. 4.

Bulletin No. 18.—A Contribution to the Investigation of the Assimilation of Free Atmospheric Nitrogen by White and Black Mustard.

OFFICE OF ROAD INQUIRY:

Bulletin No. 1.—State Laws Relating to the Management of Roads.

DIVISION OF STATISTICS:

Report No. 111 (new series), December, 1893.

Report No. 8 (miscellaneous series).—Recent Features of our Foreign Trade.

LIST OF STATION PUBLICATIONS RECEIVED BY THE OFFICE OF EXPERIMENT STATIONS.

JANUARY, 1894.

Agricultural Experiment Station of the Agricultural and Mechanical College of Alabama:

Bulletin No. 51, October, 1893.—Vegetables.

Arkansas Agricultural Experiment Station:

Sixth Annual Report, 1892.

Agricultural Experiment Station of the University of California:

Bulletin No. 103, December 15, 1893.—Distribution of Seeds and Plants.

The Connecticut Agricultural Experiment Station:

Bulletin No. 117, January, 1894.—The Babcock Method of Determining Fat in Milk and Milk Products.

The Delaware College Agricultural Experiment Station:

Fifth Annual Report, 1892.

Kansas Agricultural Experiment Station:

Bulletin No. 41, December, 1893.—The Effect of Fungicides upon the Germination of Corn.

Maryland Agricultural Experiment Station:

Bulletin No. 23, December, 1893.—Injurious Insects of Maryland.

Hatch Experiment Station of the Massachusetts Agricultural College:

Bulletin No. 22, October, 1893.—Report on Fruits.

Bulletin No. 23, December, 1893.—Electroculture.

Meteorological Bulletin No. 60, December, 1893.

Experiment Station of Michigan Agricultural College:

Bulletin No. 100, August, 1893.—Eighty New Strawberries.

Bulletin No. 101–102, December, 1893.—Composition of Wheat Straw and Certain Forage Plants; Adulteration of Ground Feed; Mineral Residues in Sprayed Fruits; Insects Injurious to Celery.

Agricultural Experiment Station of Nebraska:

Bulletin No. 31, December 20, 1893.—The Russian Thistle in Nebraska.

New Hampshire Agricultural Experiment Station:

Bulletin No. 18, November, 1892.—Effect of Food on Milk.

New Jersey Agricultural Experiment Stations:

Bulletin No. 98, December 9, 1893.—Club Root of Cabbage and its Allies.

New York Agricultural Experiment Station:

Bulletin No. 60, October, 1893.—Investigations Relating to the Manufacture of Cheese, part I.

Bulletin No. 61, November, 1893.—Investigations Relating to the Manufacture of Cheese, part II.

Cornell University Agricultural Experiment Station:

Bulletin No. 60, December, 1893.—The Spraying of Orchards.

NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 93, October 7, 1893.—Feeding Experiments.

Bulletin No. 93*b*, November 15, 1893.—Meteorological Summary for October, 1893.

Bulletin No. 93*c*, December 15, 1893.—Meteorological Summary for November, 1893. Work of State Weather Service.

NORTH DAKOTA AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 11, November, 1893.—Grain and Forage Crops.

OKLAHOMA AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 8, October, 1893.—Test of Varieties of Wheat.

AGRICULTURAL EXPERIMENT STATION OF UTAH:

Bulletin No. 25, October, 1893.—Fruits; and Forest, Shade, and Ornamental Trees.

Bulletin No. 26, December, 1893.—Subirrigation *vs.* Surface Irrigation. Water for Irrigation.

WEST VIRGINIA AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 32, May, 1893.—Catalogue of West Virginia Forest and Shade Tree Insects.

Bulletin No. 33, September, 1893.—Subirrigation in the Greenhouse.

WYOMING AGRICULTURAL EXPERIMENT STATION:

Annual Report, 1893.

Bulletin No. 15, December, 1893.—The Winterkilling of Trees and Shrubs.

Bulletin No. 16, December, 1893.—Grasses and Forage Plants.

PUBLICATIONS OF THE OFFICE OF EXPERIMENT STATIONS.

The Office of Experiment Stations issues three classes of publications for general distribution:

(1) Experiment Station Record and (2) Bulletins, which are more or less technical. It is the practice to send to persons applying for them one or more numbers, from which they may judge of their usefulness, but not to place any names upon the mailing list until after receipt of applications on special blanks furnished by the office.

(3) Farmers' Bulletins, which are brief and popular in character, and are sent on application. These bulletins are issued as part of the general series of Farmers' Bulletins of the Department of Agriculture.

The following publications have been issued:

Experiment Station Record, vol. I, 6 numbers; vol. II, 12 numbers; vol. III, 12 numbers and index; vol. IV, 12 numbers, including index; vol. V, Nos. 1-5. Copies of the Station and Department publications abstracted in the Record can, in many instances, be obtained on application.

Bulletins.—No. 1, Organization and History of the Stations; No. 2, Digest of Annual Reports of the Stations for 1888, in two parts; No. 3, Report of Meeting of Horticulturists at Columbus, Ohio, June, 1889; No. 4, List of Station Horticulturists and Outline of their Work; No. 5, Organization Lists of Stations and Colleges, March, 1890; No. 6, List of Station Botanists and Outline of their Work; No. 7, Proceedings of the Fifth Annual Convention of the Association of American Agricultural Colleges and Experiment Stations, Washington, D. C., August, 1891; No. 8, Lectures on Investigations at Rothamsted Experimental Station; No. 9, The Fermentations of Milk; No. 10, Meteorological Work for Agricultural Institutions; No. 11, A Compilation of Analyses of American Feeding Stuffs; No. 12, Organization Lists of the Agricultural Experiment Stations and Agricultural Schools and Colleges in the United States, June, 1892; No. 13, Organization Lists of the Agricultural Experiment Stations and Agricultural Schools and Colleges in the United States, April, 1893; No. 14, Proceedings of a Convention of the National League for Good Roads, January, 1893; No. 15, Handbook of Experiment Station Work; No. 16, Proceedings of the Sixth Annual Convention of the Association of American Agricultural Colleges and Experiment Stations, New Orleans, Louisiana, November, 1892; No. 17, Suggestions for the Establishment of Food Laboratories.

Miscellaneous Bulletins.—No. 1, Proceedings of Knoxville Convention of Association of Agricultural Colleges and Stations, January, 1889; No. 2, Proceedings of Washington Convention of the Association, November, 1889; No. 3, Proceedings of Champaign Convention of the Association, November, 1890. (Series discontinued.)

Farmers' Bulletins.—No. 1, The What and Why of Agricultural Experiment Stations; No. 2, Illustrations of the Work of the Stations; No. 9, Milk Fermentations and their Relation to Dairying; No. 11, The Rape Plant.

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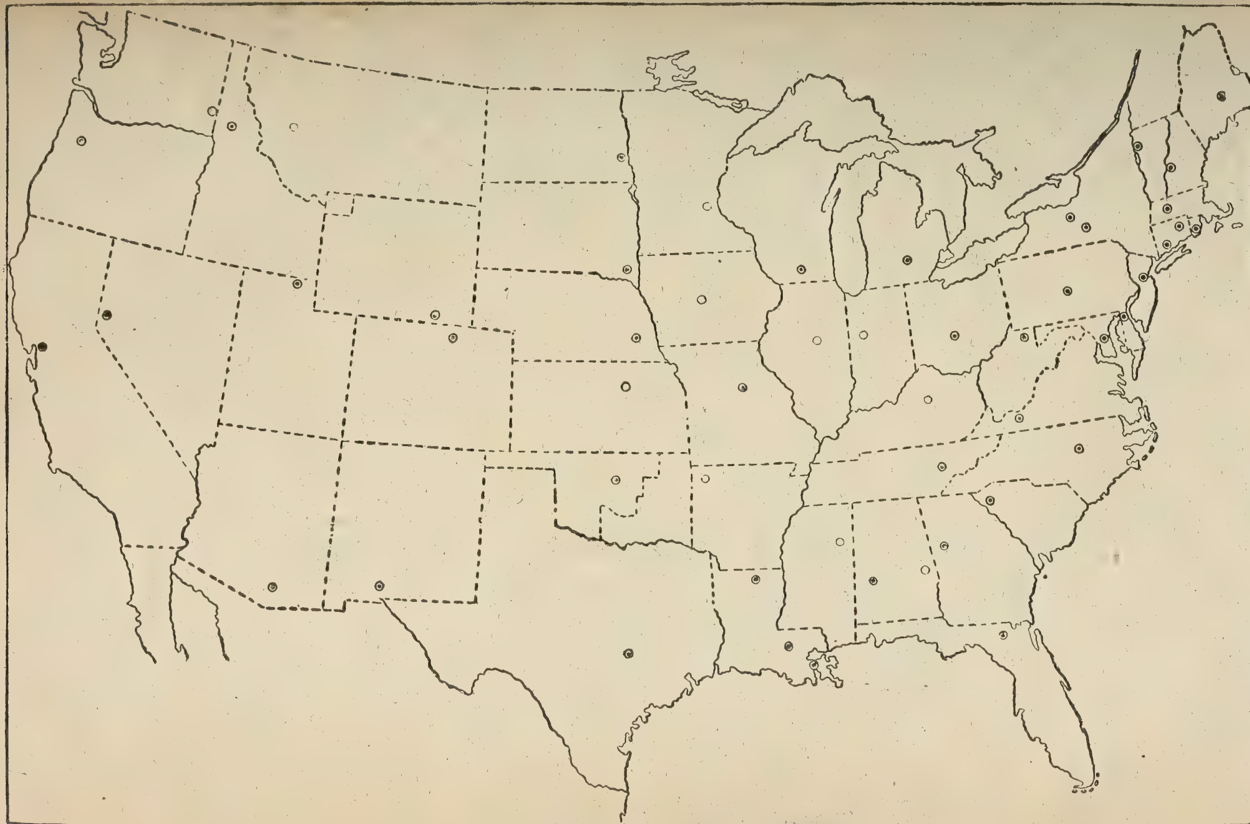

The Agricultural Experiment Stations in the United States.

R. Kent Beattie

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U. S. DEPARTMENT OF AGRICULTURE

OFFICE OF EXPERIMENT STATIONS

Vol. V No. 7

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U. S. DEPARTMENT OF AGRICULTURE

OFFICE OF EXPERIMENT STATIONS

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EXPERIMENT STATION RECORD.

VOL. V. NO. 7.

The Division of Botany of this Department has inaugurated a seed collection in connection with the U. S. National Herbarium, which is intended to include seeds of all the species of plants obtainable, especially weeds and forage plants.

The seeds, when not too large, will be placed in flat-bottomed specimen tubes of two sizes, the smaller 5 cm. long by 1.5 cm. in diameter, the larger twice these dimensions. These tubes will be labeled, systematically arranged, and placed in covered trays made of binders' board. Fleshy fruits of native American plants will be put into similar bottles filled with a preserving fluid. Authentic herbarium specimens of plants raised from the seeds represented or of plants from which the seeds were obtained will accompany the collection whenever possible.

Seeds of North American weeds, grasses, and other forage plants are especially desired and the coöperation of all botanists is earnestly requested. As far as practicable, exchanges of seeds, herbarium material, or the publications of the Division will be made. In the case of weeds and forage plants a liter of seed is desired in order that collections may be prepared for distribution to agricultural colleges.

In addition to the work above outlined the Division of Botany is about to undertake the testing of various seeds as to their purity and germinative power. For this purpose a laboratory will be fitted up and equipped after the most approved methods of American and European seed-control stations. In this laboratory and in the open air physiological experiments connected with seed germination and development will be conducted. Histological studies may ultimately be made to determine the structure of the seeds of American weeds and forage plants, and, if possible, to elicit facts of taxonomic value. The entire work will be carried on with especial regard to its economic importance, while the collection will be particularly useful for reference. Mr. G. H. Hicks, recently instructor in botany at the Michigan Agricultural College, will have charge of this work under direction of the Botanist of the Department.

The report of experiments at the North Carolina Station (see p. 686) on the feeding value of silage made of a mixture of green soja beans and fodder corn is of much practical interest as it adds another link to our meager knowledge on this subject. One drawback to the extensive feeding of corn silage, and to corn in general, is its low percentage of protein. It has been suggested to remedy this in the case of silage by mixing a quantity of green soja bean or some other green leguminous crop with the corn and ensiling the two together. Goessmann tried this and found that the mixed silage, consisting of equal parts by weight of fodder corn and nearly mature soja bean, kept well and contained more than one and one half times as much protein and ether extract in the dry matter as the silage from the same corn ensiled alone. The exact figures were 14.27 per cent of protein as compared with 8.97 per cent, and 5.37 per cent of crude fat as compared with 3.27 per cent. The relation of nitrogenous to nonnitrogenous materials was 1:9.9 in the corn silage and 1:5.7 in the mixed silage. Dr. Goessmann says: "The composition of the dry vegetable matter of the mixed silage compares well with that of a medium quality of red clover hay."

Recently the North Carolina Station tested the digestibility of mixed soja-bean and corn silage by feeding it to goats, and found the protein to be much better digested than that of corn silage, and the other ingredients equally as well as in the case of corn silage. With reference to its feeding value it was stated in that connection: "Soja-bean silage has been fed in our stable long enough to give assurance of its value. For milch cows it has seemed to arrest the natural decline in yield for a time, when fed after a long period on corn silage. This may have been partly due to other causes, as changes in grain fed and approach of spring. Fed to a bull of a little under 1,000 pounds weight for over five weeks, at the rate of 45 pounds per day, the bull made a slow but steady gain in weight." This station now reports further trials with this mixed silage, feeding it to steers and to a bull. Good gains were made for a long period, even when the food consisted very largely of the mixed silage; and the silage was eaten with little waste.

In view of the favorable results thus far secured it seems desirable that this manner of making silage be given a thorough practical trial. Experiments in ensiling cowpeas and other leguminous crops have shown their adaptability for that purpose. The silage is of good quality and is relished by cows. It has been suggested that the corn and soja bean or cowpea be grown together or so that they can be conveniently mixed when harvested. Such practice would enable the farmer to take advantage of the free nitrogen of the air and incorporate it into his crops even when growing corn for silage, and would result in a considerable saving of grain.

EXPERIMENT STATIONS IN HOLLAND.

W. O. ATWATER.

The following account of the experiment stations in the Kingdom of Holland is taken in part from published reports by Prof. Adolf Mayer,* in part from personal communications by Prof. Mayer, and in part from notes of a late visit by the writer at the station in Wageningen.

The first experiment station in Holland was established in 1877, nearly twenty-five years after the founding of the first institution of the kind in Germany. According to Prof. Mayer the reason why experiment stations were introduced in Holland so much later than in several of the other countries of Europe is really fourfold. The general spirit of the Government is less paternal; in other words, the Government concerns itself less with the establishment of institutions and regulations for special purposes of public welfare. The activity of the country is more commercial. Holland has extensive relations with its colonies in different parts of the world, and relatively more of its energy is devoted to trade and less to agriculture than is the case with most other countries of Europe. The agricultural societies of the different countries are not united and their influence is not centralized as it is, for instance, in Germany. And finally the farmers themselves are well-to-do, contented, conservative, and slow to adopt new ideas.

An institution which has been regarded as a sort of experiment station has existed for not far from thirty years in the Experimental Garden at Deventer, which was established and has been supported by a society. Its purpose, however, has been almost entirely horticultural; it has had no laboratory, and has carried on very little of experimental research.

A number of men connected with educational institutions in Holland have been actively engaged in agricultural inquiry for many years. Chief of these was the late Prof. Mulder, author of *Die Chemie der Ackerkrume*, whose work in agricultural and physiological chemistry is widely known. To a later generation of men distinguished in agricultural investigation belong Prof. Gunning, of the University of Amsterdam; Prof. van Bemmeler, of the University of Leyden; Prof. L. Mulder, formerly of Deventer; and Mr. G. Reinders, instructor in a secondary school in the province of Groningen.

* Landw. Vers. Stat., 21, p. 243; 23, p. 157; 24, p. 71, and 38, p. 441.

THE WAGENINGEN STATION.

The occasion of the establishment of the first actual experiment station was the organization of a new agricultural academy. An agricultural school formerly existed in loose connection with the university at Groningen, but it was not successful, and after a time was given up. Attempts were made to meet the need for agricultural instruction by adding it to the courses of the higher secondary schools in different provinces, but the effort failed for lack of the right kind of teachers and appliances. At length steps were taken to found a central agricultural school with the support and under the control of the Government, and, as the result of the labors of Dr. Salverda and others, an institution of the secondary school grade, called the *Rykslandbouwschool*, was established under the direction of the Minister of the Interior at Wageningen, an old and quaint but pleasant village not far from the city of Arnheim. In general character this school somewhat resembles the German agricultural academies, such as that at Hohenheim. It is located on a farm, is well equipped with buildings and appliances for instruction, and has been fortunate in having a competent corps of instructors, a number of whom have attended German agricultural schools, and several have been of German birth and training.

The first experiment station in Holland was established at Wageningen at the same time as the school, and like the school it is under the control of the ministry of the interior. Its official name is *Proefstation der Rykslandbouwschool*, or more briefly, *Ryksproefstation.* Dr. Adolph Mayer, a young German who had already distinguished himself as an agricultural chemist and whose writings and investigations have become well known in the United States, was made director. Competent assistants were appointed and operations were begun early in the year 1877. The work was carried on with an earnest spirit and the station speedily became a success.

At the outset and for a number of years the principal work of the station was that of examining fertilizers, seeds, feeding stuffs, soils, and the like. Here, as in many other instances, there was more demand for the exercise of the so-called control of commercial wares than for abstract inquiry. At the same time arrangements were made for experimenting in the laboratory and in the field. In 1880 provision was made for the erection of a plant house, and at about the same time the enlargement of the facilities of the school for practical instruction and dairying increased the resources of the station in this direction.

At the head of the management of the station was the director, who was likewise instructor in agricultural chemistry in the school. In certain respects the director of the station is subordinate to the director of the school, but in the nomination of assistants and other members of the station staff he is responsible to the Minister of the Interior.

The arrangements for control of fertilizers and feeding stuffs in Holland were prescribed by law. A regular form of contract was made by Government authority to apply to articles sold. Opportunity was given to dealers to sign this contract. They thus obligated themselves to state and guaranty the character and composition of their wares, which it was made the function of the station to examine. The inspection of the goods at the place of sale by the officers of the station was not made a prominent feature of the control. Arrangements were also made for the examination of feeding stuffs, although not for a similar official control.

The financial responsibility for the station was by its organization assumed entirely by the Government. All receipts for analysis and the like are covered into the treasury from which the expenses of the station are paid. Provision is made for annual estimates of expenses, to be made by the director of the station and transmitted by the director of the school to the Minister of the Interior. The total expense of the station for the year 1878 was 9,550 florins (about $3,920), of which a little over $1,200 was received from fees, and the rest was paid by the Government. During the same year, which was the first in which the station had been fully organized, the number of specimens analyzed or otherwise examined included 219 of fertilizers, 218 of seeds, 137 of feeding stuffs, 16 of other agricultural products, and 99 of soils, making a total of 689.

The Wageningen station thus fairly established moved on successfully for some ten years. Its force came to include, besides the director, three assistants and the necessary laboratory servants and helpers. The number of paid analyses rose from 689 in 1878 to 1,886 in the year 1889. Its work came to be more and more widely appreciated and the establishment of other stations was talked of.

OTHER STATIONS IN HOLLAND.

About the year 1879 the agricultural depression began to be felt in Holland. As it increased in severity the means for relief were considered more and more. In the year 1886 the Government appointed a commission of 25 persons to investigate and report upon the causes and means for betterment. The report of this commission, made some time later, included recommendations for enlargement of the agricultural instruction and the establishment of more experiment stations. The recommendations regarding experiment stations were adopted by the Government.

As a result three new stations were established in 1889, all with Government support and control—one at Groningen, in northern Holland; one at Hoorn, in the rich dairy region of the West Friesian peninsula, and one in the southwestern part of the Kingdom, at Breda, in a region where the sugar beet is largely cultivated. Among the special reasons for locating the stations at Groningen and Breda was the

existence in the former place of the university and in the latter of an academy, as experience, especially in Germany, had shown the great benefit of having the stations in close connection with educational institutions and the decided disadvantage under which they labor when located in isolated places in the country. The station at Hoorn is less favorably situated in this respect, but it is so near to Amsterdam, which is the seat of a university and a center of intellectual activity, that the disadvantage is not so great as it otherwise would be.

The station at Wageningen was continued, but arrangements were made by which it was relieved of a large part of its work in connection with control of fertilizers, seeds, and feeding stuffs, and enabled to give its attention more exclusively to scientific inquiry. It was at the same time made specifically a department of the Agricultural Academy. While it remained subject to the Ministry of the Interior the other stations were placed in the charge of the ministry of commerce and industry.

HOLLAND EXPERIMENT STATIONS IN GENERAL.

The organization and functions of the Holland stations are defined by royal decree. In accordance with this the director of each station is appointed by the king. The assistants and servants are nominated by the director and appointed by the minister. The officers of the station receive, in addition to their yearly salaries, certain percentages of the fees for analyses, the director having 5 per cent, each assistant 3 per cent, and the servants 1 per cent of the total amount. The directors of the three last established stations, with the director of the station at Wageningen, form a board of which the director last named is the president. This board has to do with the general interests of the stations. It meets at least twice each year, decides upon official methods of investigation, which must be continued for at least a year, arranges for annual reports, and makes propositions for alterations in the station regulations and schedules of prices for analyses. These propositions are submitted to a commission which has the general charge of the stations.

The experiment station commission just named consists of not less than 5 nor more than 8 persons, appointed by the king. Each member holds office five years and may be reappointed. The commission decides upon its own rules of action, which must, however, be approved by the Minister of the Interior. In effect, this commission under the minister has the general oversight of the experiment station system.

The examinations of materials made in the exercise of control of fertilizers, feeding stuffs, etc., are carried on in accordance with the methods decided upon as above explained. The Government assumes no responsibility for the correctness of the results, but in case of dispute the central station at Wageningen is made the referee.

Among the special regulations is one which provides that no station official shall engage in analyses or examinations on his own account.

METHODS OF ANALYSES.

These are, for the most part, the same as used by the German stations, and differ but little from the methods of the United States Association of Official Agricultural Chemists. Among the points of difference, which are mainly those of minor detail, the following may be mentioned:

In the determination of nitrogen by the Kjeldahl method, the potassium or sodium sulphide used to precipitate the mercury is mixed with the concentrated soda solution when the latter is prepared, thus slightly diminishing the amount of manipulation.* In the determination of fat (ether extract) in feeding stuffs, when a first extraction has been made in the usual way, and the reaction of extracted material is found to be strongly acid, the latter is neutralized with alcoholic solution of potash, to make potassium salts of acids such as lactic acid; thereupon the whole extract is dried, *i. e.*, freed from alcohol, and then treated again with ether to separate the pure fats.

Crude fiber is determined by the method of Holdefleiss. †

The substance is brought into a pear-shaped receptacle, somewhat like a separatory funnel. At the junction of the stem with the funnel proper, a mat of glass wool or asbestus is introduced, and the lower end of the stem is closed with a rubber stopper. The substance is treated in the ordinary manner with acid and alkali, the boiling being produced by passing live steam through the liquid. The liquid is drawn off through the stem, the mat serving as a filter. By the use of this apparatus the removal of the material from the flask for washing is obviated.

In analysis of Thomas slag the material is sifted in sieves of 1.5 mm. mesh and the portion which does not pass through is counted as valueless.

To what was said of the examination and control of fertilizers, feeding stuffs, etc., the following may be added: All dealers in fertilizers who subscribe to the contract to guarantee their wares are obliged by the terms of the contract to state the composition of all wares sold. The sales may be (1) upon the basis of the actual percentages of valuable ingredients, *i.e.*, by "units," as is common with us in the wholesaling of nitrogenous fertilizers by units of ammonia; in such cases the per cent of each valuable ingredient is rated at a certain price and the percentages are determined by analysis at the station of samples of the articles as sold. Or (2) the sale may be at a fixed price for material of stated composition, as the more common retail practice with us. When the sale is on this basis, provision is made for recompense by the seller in case the percentages are found by station analyses to fall below the guaranty.

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* This has been found advantageous in the experience in the writer's laboratory.

† See Maercker, Bieler, and Schneidewind Ftsch. Die Versuchsstation Halle a/S, p. 18; Landw. Jahrbücher 6, Sup. p. 101; anal. Chem., 16, 498; and Experiment Station Record, vol. 5, p. 459

In the guaranties of percentages a certain range is, however, allowed. This is in fertilizers, for potash and phosphoric acid 1 per cent; nitrogen, 0.5 per cent; in feeding stuffs the range is, protein (N. X. 6.25), 2 per cent; fat, 1 per cent; nitrogen-free extract, 4 per cent.

The sellers guarantying their wares under contract pay certain fees toward covering the expense of the analyses. The annual rates for each dealer are: For any number of determinations up to 50, 50 gulden ($20.50); from 51 to 150 determinations, $30.75; for any number of determinations larger than 150, $41.

Examinations are also made for individuals at certain rates. Thus the tariff of 1892–'93 included the following rates for citizens of Holland. Double these prices were charged to foreigners:

FERTILIZERS.

	Cents.
Moisture	21
Phosphoric acid, water soluble	62
Phosphoric acid, citrate soluble	62
Phosphoric acid, total	62
Nitrogen, as ammonia	51
Nitrogen, as nitric acid	51
Nitrogen, other forms	62
Nitrogen, total	82
Potash	62

FEEDING STUFFS.

	Cents.
Moisture	21
Protein	62
Fat	41
Crude fiber	62
Ash	21

For analyses in large numbers the directors of the stations are allowed to make contracts at lower prices, at their discretion, with the consent of the minister of the interior.

In brief, the Government provides laboratories and experts for the testing of wares as sold, and makes regulations by which dealers who choose can place their goods under control on the condition that they agree to state exactly the character of their wares, pay a small part of the expense of the examination, and make good any deficiencies in the quality of the materials they sell.

The experiment station system in Holland is in many respects similar to that in Belgium.* In each country there are stations in the different provinces devoted especially to examinations of agricultural and other products, and a central station connected with the principal schools of the country and devoted more especially to experimental inquiry. The system in each country is organized by the Government, which pays all of the expenses, except in so far as the latter are covered by receipts for the examinations of products sold. The adoption of uniform laboratory

*See Experiment Station Record, vol. 5, p. 550.

methods is providedfor, as the Government also makes specific arrangements for the examination and control of the sale of agricultural products. But the control in each case is entirely voluntary. Sellers are at liberty to place themselves under it or not, as they choose, and buyers may deal with dealers under the control or not, as they like. In each case the organization of the experiment station system is based upon the experience in neighboring countries, but is modified to suit the conditions of the country in which the stations are located. In both countries the experiment stations have been in operation for a considerable number of years, and have become a prominently useful part of the educational and scientific systems.

The following are some of the lines of experimental inquiry followed by Prof. Mayer and his associates, mainly at the Wageningen Station: (1) Soils, fertilizers, etc.; (2) respiration of plants, and kindred questions in vegetable physiology; (3) fermentations; (4) the effects of climate, methods of culture, fertilizers, and other factors upon the development and quality of tobacco; (5) feeding stuffs, including especially the effects of methods of curing and treatment (silage); (7) milk, butter, and oleomargarin, including methods of analysis, digestibility, and nutritive values.

The location of stations and directors, in 1893, were as follows:

Wageningen, Central Station: Director, Prof. A. Mayer; chief of division of seed control, F. F. Bryning.

Goes (station removed in 1893 from Breda): Director, Dr. A. J. Swaving.

Hoorn: Director, Sir Dr. K. H. M. van der Zande.

Groningen: Director, A. F. Holleman.

The station at Wageningen has two assistants and the others one each, besides laboratory servants and helpers.

ABSTRACTS OF PUBLICATIONS OF THE AGRICULTURAL EXPERIMENT STATIONS IN THE UNITED STATES.

CHEMISTRY—MINERALOGY—ZOÖLOGY.

Report of chemist, R. C. KEDZIE (*Michigan Sta. Report for 1892, pp. 181–184*).—A brief outline is given of the work of the chemical department of the station during the year, including the examination of fertilizers, wheat and wheat straw, and honey, and meteorological observations (see below). A plan of proposed work in 1893 is submitted.

Notes on the mineral resources of Wyoming, W. C. KNIGHT (*Wyoming Sta. Report for 1893, Appendix, pp. 103–212*).—A reprint of Bulletin No. 14 of the station (E. S. R., vol. V, p. 567).

Ground squirrels, F. J. NISWANDER (*Wyoming Sta. Report for 1893, Appendix, pp. 23–35*).—A reprint of Bulletin No. 12 of the station (E. S. R., vol. IV, p. 802).

METEOROLOGY.

W. H. BEAL, *Editor*.

Meteorological observations at the Massachusetts Hatch Station, C. D. WARNER and F. L. WARREN (*Massachusetts Hatch Sta. Met. Bul. No. 60, Dec., 1893, pp. 4*).—Daily and monthly summaries of observations for December, 1893, and a general summary for the year.

The annual summary is as follows: *Pressure* (inches).—Actual maximum, 30.61, December 14, 9 a. m.; actual minimum, 28.69, February 20, 1 a. m.; mean reduced to sea level, 30.047; annual range, 1.92. *Air temperature* (degrees F.).—Maximum, 96, June 20; minimum, −3, January 17; mean, 47.7; annual range, 99; maximum mean daily, 83.8, June 20; minimum mean daily, 4.7, January 17; mean maximum, 55.7; mean minimum, 39.9; mean daily range, 12.7; maximum daily range, 38, February 6; minimum daily range, 1, February 13. *Humidity.*—Mean dew-point, 37.9; mean force of vapor, 0.4145; mean relative humidity, 71.1. *Precipitation.*—Total rainfall or melted snow, 46.94 inches; number of days on which 0.01 inch of rain or melted snow fell, 143; total snowfall in inches, $74\frac{1}{4}$. *Weather.*—Mean cloudiness observed, 50 per cent; total cloudiness recorded by the sun thermometer, 2,434 hours,

or 54 per cent; number of clear days, 101; number of fair days, 96; number of cloudy days, 168. *Wind.*—Direction, N., 16 per cent; SW., 15 per cent; NW., 14 per cent; S., 11 per cent; total movement, 52,411 miles; maximum daily movement, 486 miles, October 14; minimum daily movement, 5 miles, January 23; mean daily movement, 143.6 miles; mean hourly velocity, 6 miles; maximum pressure per square foot, 37½ pounds=86½ miles per hour, August 29, 3 p. m. *Bright sunshine.*—Number of hours recorded, 2,072. *Mean ozone*, 31 per cent. *Dates of frost.*—Last, May 8; first, September 3. *Dates of snow.*—Last, April 21; first, November 4.

Meteorological observations at Michigan Station, R. C. KEDZIE (*Michigan Sta. Report for 1892, pp. 184–213*).—Tabulated daily and monthly summaries are given, of observations during 1891, on hours of sunshine, sunshine temperatures, temperature of the air, atmospheric pressure, pressure of aqueous vapor, precipitation, relative humidity, and wind movement, together with a record for six years of the temperature of the water of a river flowing through the college grounds.

The summary for the year, prepared from the monthly means, is as follows: Mean daily temperature of the air, 47.4° F.; mean maximum temperature, 57°; mean minimum, 37.10°; percentage of humidity, 70.26; pressure of aqueous vapor, 0.232; mean height of barometer reduced to 32° F., 29.113; percentage of cloudiness, 59; total amount of rain or melted snow, 24.78 inches; total depth of snow, 29.75 inches; and number of thunderstorms, 13.

Meteorological summaries for North Carolina for October and November, 1893, H. B. BATTLE, C. F. VON HERRMANN, and R. NUNN (*North Carolina Sta. Buls. Nos. 93b, Nov. 15, 1893, pp. 22, charts 2; and 93c, Dec. 15, 1893, pp. 22, charts 2*).—These bulletins contain the usual summaries of observations on temperature, pressure, precipitation, etc., by the State weather service, coöperating with the U. S. Weather Bureau. Bulletin No. 93*c* contains a special article on the objects of the service and the results accomplished since its organization.

The State weather service was established in 1886, and since that time has been in operation as the meteorological division of the North Carolina Agricultural Experiment Station.

An important part of the work is the collection of meteorological data determining the climate of the State. Reports are received from about sixty-six voluntary observers and regular observers of the Weather Bureau, and fifty monthly meteorological bulletins and six annual reports have been published, which contain all the reliable data pertaining to the climate of North Carolina ever collected. * * *

The weather service also renders practical benefit to the people of the State by the distribution of the daily weather forecasts, frost, cold-wave and storm warnings, which may be put to immediate use in the everyday operations of life, and are especially valuable to agricultural and horticultural interests.

The daily forecasts, issued for thirty-six hours in advance, and distributed by telegraph to sixty places and by mail to nearly three hundred towns in the State are steadily improving in accuracy and consequent benefit to farmers and others.

The frost and cold-wave warnings yearly save thousands of dollars of damage to the tobacco, trucking, and fruit interests by giving information in advance of the approach of sudden cold spells in autumn and spring. * * *

The issue of the Weekly Weather Crop Bulletin during the season of growing crops gives valuable information to farmers and others of the current condition of crops and prevents outside misrepresentation, which would be detrimental to their interests. * * *

Valuable information for the use of engineers can be furnished in regard to excessive rainfalls.

To physicians the material collected by the State weather service will be found a valuable help in studying the relation of climate and diseases. * * *

Reports are also received daily by telegraph of the average temperature and rainfall throughout the cotton region for the benefit of those interested in that crop. * * *

For North Carolina a fair determination of the climatic conditions, with special reference to the distribution of temperature and rainfall, has been made, and the local climatic peculiarities of many places have been ascertained. Charts of normal temperature and rainfall for the State have been published, which will be found of great value in studying various important questions of the relations of soil, crops, and climate.

The accumulation of records of the meteorological elements, now already carried on for six years, is indispensable for the study of important questions which await solution, such as, for instance: "What regions of the State are climatically more suited to certain crops than others?" "What conditions of the weather are most suitable for the production of the largest crops of tobacco? of cotton? of corn?" "Under what weather conditions do insect pests thrive?" etc.

FERTILIZERS.

W. H. BEAL, *Editor.*

Inspection of commercial fertilizers, R. C. KEDZIE (*Michigan Sta. Report for 1892, pp. 271–279*).—A reprint from Bulletin No. 86 of the station (E. S. R., vol. IV, p. 248).

FIELD CROPS.

J. F. DUGGAR, *Editor.*

Grain and forage crops, W. M. HAYS (*North Dakota Sta. Bul. No. 11, Nov., 1893, pp. 32*).

Synopsis.—The crops under experiment were wheat, oats, barley, millet, flax, and peas. On all of these tests of varieties were made; on wheat and oats, tests of time and methods of sowing; on wheat, tests of plowing to different depths and of distances between the drills; and for wheat, barley, and flax, tests of the amount of seed. The results for 1892 and 1893 of an experiment in the rotation of crops are given.

Thickness of seeding wheat (pp. 5, 6, 8).—Spring wheat was sown at rates of 3, 4, 4½, 5, and 6 pecks of seed per acre. With Fife wheat 5

pecks, and with Haynes Blue Stem 6 pecks, gave the maximum yield. Distances of 3 and 3½ inches between the drills gave larger yields than distances of 6, 7, 12, and 14 inches.

Methods of preparing land and seeding wheat and oats (pp. 9–13, 18–20).—On land plowed to a depth of 2.34 inches the yield per acre of wheat was 9.1 bushels; plowed 4.76 inches deep, 10.3 bushels; plowed 7.22 inches deep, 9.7 bushels. Many of the experiments with wheat and oats were a failure and the crop was plowed under. With both grains the shoe-chain drill and shoe-press drill gave better yields than the hoe drill, and far better yields than broadcasting. With wheat spring plowing gave the best results; with oats fall plowing gave slightly the best results.

Time of sowing wheat (pp. 5, 6).—Two varieties of wheat were sown May 19 and 29, the earlier sowing giving, on an average, the larger yield.

Varieties of wheat and oats (pp. 5–7, 14–17, 21, 22).—The average yield of 10 plats of Haynes Blue Stem was 6.3 bushels more than the average of the adjacent 10 plats of Fife wheat. One hundred and ten samples of wheat, embracing many varieties and strains, were tested, and tabulated data for each are given. Twenty-eight varieties of oats were tested.

Varieties of barley (p. 24).—Of fifteen varieties tested the largest yield, 35.9 bushels per acre, was made by Improved Black.

Thickness of seeding barley (p. 25.)—Common six-rowed barley was seeded at the rate of 6, 7, 8, 9, 10, and 11 pecks per acre. The largest yield resulted from sowing 10 pecks.

Varieties of millet (p. 25).—On account of a failure in the crop, data for this experiment are not given.

Varieties of flax (p. 26).—Four varieties of flax were grown. The yield of straw ranged from 798 to 1,560 pounds per acre; of grain, from 9.8 to 17.4 bushels per acre.

Thickness of seeding flax (p. 26).—Two pecks of flaxseed per acre yielded 1,392 pounds of straw and 14 bushels of seed; 3 pecks per acre yielded 1,110 pounds of straw and 10.5 bushels of seed per acre.

Rotation of crops (pp. 27–30).—Tabulated data for the crops of 1892 and 1893 grown on rotation plats are given.

Varieties of field peas (pp. 30–32).—Thirty-one varieties of peas were tested, the yields ranging from 5.2 to 23.1 bushels per acre.

Grasses and forage plants, B. C. BUFFUM (*Wyoming Sta. Bul. No. 16, Dec., 1893, pp. 223–248*).—Notes on native grasses and on twenty varieties of grasses and forage plants grown without irrigation, and extended notes on alfalfa, sainfoin (*Onobrychis sativa*), red clover, white sweet clover (*Melilotus alba*), blue stem (*Agropyrum* sp.), redtop (*Agrostis vulgaris*), gramma grass (*Bouteloua oligostachya*), awnless brome grass (*Bromus inermis*), red fescue (*Festuca rubra*), English rye grass (*Lolium perenne*), timothy (*Phleum pratense*), and Johnson grass

(*Sorghum halepense*). A catalogue of the forage plants of Wyoming and notes on dodder and ergot are given.

Grasses and forage plants, B. C. BUFFUM (*Wyoming Sta. Report for 1893, Appendix, pp. 223–248*).—A reprint of Bulletin No. 16 of the station (E. S. R. vol. v. p. 679).

Potatoes, L. R. TAFT (*Michigan Sta. Report for 1892, pp. 251–270*).—A reprint from Bulletin No. 85, of the station (E. S. R., vol. III, p. 872).

Report of the agriculturist of Michigan Station, P. M. HARWOOD (*Michigan Sta. Report for 1892, pp. 175–177*).—Brief general notes on the lines of work pursued during the year, with a short report of the substation at Grayling.

Wyoming crop report for 1892, A. A. JOHNSON and F. J. NISWANDER (*Wyoming Sta. Report for 1893, Appendix, pp. 1–22*).—A reprint of Bulletin No. 11 of the station (E. S. R., vol. IV, p. 825).

HORTICULTURE.

Subirrigation in the greenhouse, F. W. RANE (*West Virginia Sta. Bul. No. 33, Sept., 1893, pp. 225–270*).

Synopsis.—In greenhouse experiments to test the relative advantages of subirrigation and surface watering, subirrigation was found to hasten the maturity of parsley, long-rooted radishes, and spinach, and to increase the yield of tomatoes, lettuce, and long-rooted radishes. On turnip-rooted radishes and on beets subirrigation gave no marked beneficial results.

In each of three greenhouses one bed was devoted to subirrigation and a similar bed was used for surface watering. Iron and lead pipes placed 21 inches apart and covered with 6 inches of soil were used for subirrigation. The punctures in the pipes for watering the soil were 4 inches apart. In one bed both ends of the pipe were carried out above the surface of the ground; in the others only the receiving end of the pipe was above ground, the other end being closed. To make the distribution of water as even as possible, in the end of the pipe, near the point where the water entered, these holes were drilled high up on the side of the pipe and gradually lowered until the point farthest from the receiving elbow was reached.

Parsley on the subirrigated beds was ready for market when that in the surface-watered beds was not over one third grown. Subirrigation largely increased the yield of tomatoes, lettuce, and long-rooted radishes; but it showed no marked favorable effect on turnip-rooted radishes or on beets. The maturity of spinach was slightly hastened by subirrigation.

Subirrigation once a week sufficed, but surface watering daily was generally necessary. Other advantages of subirrigation noted were economy of time, labor, and water, ease of cultivation, and decrease in the amount of injury from fungus diseases.

The cost of making beds for surface watering in a greenhouse 50 by 20 feet was estimated at $12.28, and for subirrigation $30, a difference of $17.72 in the first cost of beds for the two systems, only half of which, $8.86, is chargeable to the expenses of one year, as the beds are supposed to last two years Despite the increased first cost, subirrigation was found to be more economical and satisfactory.

Report on fruits, S. T. MAYNARD (*Massachusetts Hatch Sta. Bul. No. 22, Oct., 1893, pp. 15*).—Tabulated data for 108 varieties of strawberries, 14 of blackberries, 20 of blackcap raspberries, and 20 of red raspberries. The following are especially recommended: *Strawberries.*—Beder Wood, Beverly, Bubach No. 5, Haverland, Iowa Beauty, Greenville, Michel Early, Mrs. Cleveland, Pacific, Parker Earle, Rheil No. 1, Shuster Gem, and Warfield. *Blackberries.*—Agawam, Erie, Snyder, Taylor, Wachusett, and Lucretia Dewberry. *Blackcap raspberries.*—Hilborn, Ohio, Souhegan, and Kansas. *Red raspberries.*—Cuthbert, Golden Queen, Hansell, Marlboro, Thompson Early Prolific, Thompson Pride, and Japanese Wineberry. Brief notes on strawberry leaf blight, the strawberry flea or black paria, and May beetle, or June bug, are also given.

Notes on strawberries, L. R. TAFT and H. P. GLADDEN, (*Michigan Sta. Bul. No. 100, Aug., 1893, pp. 15*).—Notes on 74 varieties of strawberries. The following varieties are commended: Clyde, Greenville, Leroy, No. 1 (Allen), No. 2 (Feicht), No. 3 (Stayman), Weston, and Yankee Doodle.

Report of the horticulturist of Michigan Station, L. R. TAFT (*Michigan Sta. Report for 1892, pp. 177–180*). Brief notes on the work of the year, with mention of the work done at the substations at South Haven and Grayling.

Fruits, nuts, and vegetables, T. T. LYON (*Michigan Sta. Report for 1892, pp. 289–315*). A reprint from Bulletin No. 88 of the station (E. S. R., vol. IV, p. 555).

Fruits at Utah Station, E. S. RICHMAN (*Utah Sta. Bul. No. 25, Oct., 1893, pp. 1–11*).—Notes on 44 varieties of strawberries, 9 of raspberries, 29 of grapes, and brief notes on blackberries, dewberries, gooseberries, peaches, apricots, cherries, and plums. The author summarizes his results as follows:

Parker Earle has given better satisfaction than any other strawberry so far. Greenville is most promising of any of the varieties which fruited this year for the first time.

Thompson Early Prolific raspberry is very promising for this locality.

Grapes do well here, if we except such varieties as ripen later than Concord. A good list to select from for the extreme northern part of Utah is: Early Victor, Worden, Concord, Delaware, Niagara, Prentiss, and Empire State.

Late peaches must be excluded from our list of possibilities for Logan.

The Russian apricots promise to be very valuable here, particularly the Gibb and Budd.

FORESTRY.

The winterkilling of trees and shrubs, A. NELSON (*Wyoming Sta. Bul. No. 15, Dec., 1893, pp. 213–222*).—A popular bulletin on the cause of winterkilling of trees and shrubs. This question is of especial interest in arid regions of the higher altitudes where forestry and pomology are carried on with great difficulty. The author considers desiccation caused by transpiration as the principal cause of the loss, and offers some suggestions as to how this drying out may be prevented. The conditions to which the trees and shrubs are subjected in these high elevations tend to cause greater transpiration than is normal, through the greater intensity of light and an increased temperature caused by the action of the rays of the sun falling upon the objects growing in a rarefied atmosphere. An excessively dry atmosphere tends to increase the temperature, which in turn stimulates root activity, and even in moist soil the roots are not quite able to make good the loss. Much more is this true in dry or frozen soils. That plants do transpire at a low temperature has already been shown. The leafless shoots of the horse-chestnut will transpire at $-13°$ C. and the yew tree at $-10.7°$ C. A sandy or gravelly soil is unfavorable to the plant, as it yields its water less uniformly than clay soils. Hence the plants of the arid regions are subject to conditions which conspire against them, viz, a dry atmosphere, a gravelly soil, a great difference between the roots in the frozen soil and the branches in the intense sunlight, dry winds, and sudden temperature changes—all causing transpiration far in excess of the absorption by the roots.

By a series of experiments the author has shown that transpiration is directly and proportionately increased by the diminution of the atmospheric pressure. This added to the other causes points out plainly the cause of a large per cent of winterkilled trees and shrubs.

The remedies suggested are late irrigation and, if possible, irrigation occasionally during the winter months. The ice forming over the soil will prevent evaporation. The training of the roots in some of the less hardy fruit trees so that the trees may be laid down during the winter is recommended as of probable value in protecting the trees against sudden changes.

Winterkilling of trees and shrubs, A. NELSON (*Wyoming Sta. Report for 1893, Appendix, pp. 213–222*).—A reprint of Bulletin No. 15 of the station (E. S. R., vol. V, p. 682).

Ornamental, forest, and shade trees, E. S. RICHMAN (*Utah Sta. Bul. No. 25, Oct., 1893, pp. 11–14*).—Brief reports on the growth and present condition of 25 species of forest trees planted at the station and previously mentioned in Bulletin No. 18 (E. S. R., vol. IV, p. 653). For rapidly growing trees the poplars are recommended.

SEEDS.

WALTER H. EVANS, *Editor.*

Report of consulting botanist, C. F. WHEELER (*Michigan Sta. Report for 1892, p. 214*).—The principal investigation of the author has been in the examination of seeds of grasses and forage plants for impurities. A sample of clover seed was examined which consisted principally of screenings, containing only 10 per cent of pure clover seed, the remainder being mainly weed seeds. A small amount was weighed. By counting the number of seeds in this quantity, it was estimated that the sample contained over 60,000 weed seeds per pound.

Distribution of seeds and plants, E. J. WICKSON (*California Sta. Bul. No. 103, Dec., 1893, pp. 4*).—A descriptive list of seeds, cuttings, shrubs, and trees offered for distribution to citizens of the State.

DISEASES OF PLANTS.

WALTER H. EVANS, *Editor.*

The spraying of orchards, E. G. LODEMAN (*New York Cornell Sta. Bul. No. 60, Dec., 1893, pp. 255–296, figs. 4*).

Synopsis.—The bulletin gives notes on the profits of spraying apple orchards, tests of some fungicides and insecticides upon peach foliage, some novel insecticides and fungicides, and a summary of results.

The profits of spraying apple orchards (pp. 257–279).—For spraying orchards the spraying pumps, to be economical, should have a large capacity. The amount of liquid required to spray a full-grown apple tree is about 4 gallons. Spraying in an orchard is facilitated if the trees are far enough apart to allow a wagon to pass between the rows. Automatic agitators have not given good results.

The experiments of the author were directed principally upon apple scab, that being one of the most serious enemies of the apple. Tests were made to prevent this disease, and in doing so to determine (1) the number of applications necessary to secure fair fruit; (2) the comparative value of common fungicides; and (3) the comparative value of insecticides and the advisability of applying them in combination with fungicides. The materials used were Bordeaux mixture, ammoniacal copper carbonate, fostite, Paris green, and London purple, formulas for the preparation of which are given. Two, four, and six applications were given the trees at various intervals.

Tabular information is given showing the effect of the various fungicides upon fruit. In general, for the more susceptible varieties of apples, the greater the number of applications the better the results

obtained; but no fixed rule can be given for the number and dates of applications. As a rule a fungicide should be applied once before the trees blossom, and two applications after the falling of the blossoms are necessary upon those varieties habitually injured by the scab. On resistant varieties only one or two applications can be applied with profit. The advisability of making more than one or two applications of fungicides to such varieties as Baldwin and Fallawater apples is doubtful, but King, Maiden Blush, and Fall Pippin will repay four and possibly six applications.

Of the fungicides used, Bordeaux mixture gave decidedly the best results. Following this the order of value of the fungicides was ammoniacal copper carbonate, Paris green, and fostite.

But little difference is noted in the two insecticides, both being effective. Ordinarily two applications of insecticides are sufficient to control the ravages of the first brood of codling moths, and later applications are of doubtful value.

Arsenites and fungicides used in the apple orchard appear to be equally effective whether applied alone or in combination. Lime added to Paris green greatly prevents the injury to the foliage. The action of the fungicides upon the foliage was not injurious except in the case of the fostite. The size, color, and keeping quality of the sprayed fruit was greatly improved, and sprayed apples of the King variety sold in the market at $1 per barrel above the unsprayed crop graded as No. 1.

Tests of fungicides and insecticides upon peach foliage (pp. 280,281).—The following were each applied three times to trees: Bordeaux mixture; Bordeaux mixture and London purple; ammoniacal copper carbonate; ammoniacal copper carbonate, lime, and Paris green; Paris green; London purple, and fostite. The foliage was injured by the application of all with the exception of the Bordeaux mixture, Bordeaux mixture and London purple, and fostite. Neither Paris green nor London purple should be used upon peach trees, unless the mixtures are very dilute or lime is added to neutralize the corrosive action of the arsenites. Fostite gave only negative results when applied to peach foliage.

Novel insecticides and fungicides (pp. 282–293).—The following fungicides and insecticides were given a comparative test: Bordeaux mixture, copper chloride, iron chloride, zinc chloride, zinc sulphate, lead acetate, fostite, boron compounds, iodine, nitrate of soda, caustic potash, "abretic acid," kreolin, and antinonnin. Formulas for preparation and methods of application are given. The tests were made on the following plants: Apple, blackberry, dewberry, gooseberry, raspberry, and quince. Bordeaux mixture when properly applied protected the foliage of all from fungus attacks. Copper chloride when neutralized seems to be a promising fungicide. The experiences of the last season show no benefits arising from applications of iron chloride, zinc chloride, zinc sulphate, borax, or boracic acid, iodine, nitrate of soda, "abretic acid," or kreolin. Fostite, a powder containing about 2 per cent of copper, pos-

sesses some fungicidal value, but its application to trees is difficult and its action so moderate that it can not be generally recommended. It possesses no value when dry as an insecticide. Antinonnin is dangerous to handle, and unless used very dilute is injurious to foliage. It possesses no practical value for destroying insects by contact.

On the whole the author recommends Bordeaux mixture in combating fungi, with ammoniacal carbonate of copper as second choice. Paris green and London purple are still considered the best insecticides, the greater value generally being placed upon the Paris green.

Club root of cabbage and its allies, B. D. HALSTED (*New Jersey Stas. Bul. No. 98, Dec., 1893, pp. 16, figs. 9*).—A popular bulletin on the subject of the club root of cabbage and other cruciferous plants, largely based on an article in the Journal of Mycology, vol. VII, No. 2 (E. S. R., vol. III, p. 810). In the treatment of this disease preventive measures must be relied upon. If the crop is diseased all refuse stems, leaves, and roots should be burned, and seedlings from hotbeds showing signs of club root should be destroyed. Lime added to the land at the rate of 75 bushels per acre has proved effective. It is possible that some commercial fertilizers may be found to check this trouble. Land should be kept free from shepherd purse, hedge mustard, and other weeds of the same family, as their roots may become clubbed and thereby propagate the fungus.

Hot water treatment for smut of oats and wheat, P. M. HARWOOD and P. G. HOLDEN (*Michigan Sta. Report for 1892, pp. 280–288*).—A reprint from Bulletin No. 87 of the station (E. S. R., vol. IV, p. 352).

ENTOMOLOGY.

Injurious insects of Maryland, C. V. RILEY (*Maryland Sta. Bul. No. 23, Dec., 1893, pp. 67–94, figs. 24*).—A popular bulletin on the life history of, and remedial measures to be adopted against, the codling moth (*Carpocapsa pomonella*), June beetle (*Allorhina nitida*), imported cabbage worm (*Pieris rapæ*), cabbage plusia (*Plusia brassicæ*), cabbage mamestra (*Mamestra trifolii*), zebra caterpillar (*M. picta*), cabbage evergestis, or pionea (*Evergestis rimosalis*), cabbage plutella (*Plutella cruciferarum*), harlequin cabbage bug (*Murgantia histrionica*), round-headed apple tree borer (*Saperda candida*), flat-headed borer (*Chrysobothris femorata*), tobacco flea beetle (*Epitrix parvula*), tobacco sphinx, or horn worm (*Protoparce celeus*), melon plant louse (*Aphis cucumeris*), asparagus beetle (*Crioceris asparagi*), striped blister beetle (*Epicauta vittata*), and black blister beetle (*E. pennsylvanica*).

Report of consulting entomologist, G. C. DAVIS (*Michigan Sta. Report for 1892, pp. 215–217*).—The author reports upon the rose chafer and the celery caterpillars. The rose chafer has been exceptionally abundant in parts of the State, and experiments with hot water and

kerosene emulsion were made for its repression. Hot water was thrown in a solid stream at temperatures varying from 130° to 165° F. The work of the hot water was quicker and more certain than the emulsion, but neither was successful with the chafers on account of their great numbers. Veratrine, a form of white hellebore, made from the seeds of *Veratrum sabadilla*, was used with considerable success, but its present price is such that it is hardly a practicable remedy.

The celery caterpillars, *Papilio asterias* and *Mamestra picta*, have been very troublesome on celery during the past season. Directions are given for their treatment, and hand picking, pyrethrum, or the use of hot water is recommended.

The forest and shade tree insects of West Virginia, A. D. HOPKINS (*West Virginia Sta. Bul. No. 32, May, 1893, pp. 171–251*).—This bulletin is a catalogue of injurious, beneficial, and other insects collected during 1890 and 1893. The list consists of the name of the insect, the tree on which it was collected, the date, and other notes regarding the habits and life history. An index to families and species of insects and to the trees attacked completes the bulletin.

Insecticides and fungicides, L. R. TAFT (*Michigan Sta. Report for 1892, pp. 224–247*).—Reprint from Bulletin No. 83 of the station (E. S. R., vol. III, p. 871).

Report of the apiarist, J. R. LARRABEE (*Michigan Sta. Report for 1892, pp. 217–223*).—Reprint from Bulletin No. 30 of the Division of Entomology of this Department (E. S. R., vol. V, p. 101).

ANIMAL PRODUCTION.

E. W. ALLEN, *Editor.*

Feeding experiments, F. E. EMERY (*North Carolina Sta. Bul. No. 93, Oct. 7, 1893, pp. 46*).

Synopsis.—Three experiments are reported in feeding for beef, *i. e.*, feeding two-year-old and three-year-old steers, tied up and in box stalls, on cotton-seed hulls and meal; a comparison of corn silage and soja-bean silage when fed with cotton-seed meal to steers; and feeding a bull on corn silage or soja-bean silage alone. The best financial result was with the two-year-olds, and there was no difference between tying up and keeping loose in box stall. Soja-bean silage with cotton-seed meal appeared to be too rich a ration to secure the full value of the food. The bull fed on soja-bean silage alone made an average daily gain of nearly two pounds. A popular summary of the bulletin is given in the first seven pages.

Experiments in fattening stock for beef with cotton-seed hulls and meal (pp. 9–40).—The trial included 8 steers—two-year-olds and three-year-olds (grades and natives). These were fed on cotton-seed meal and cotton-seed hulls for six periods of twenty days each. The proportion of cotton-seed meal to hulls was 1:4 in the first, second, and sixth periods, and 1:6 in the three remaining periods. In these proportions, food was

given *ad libitum*. Some of the hulls were frequently left uneaten. Part of the steers were tied in stalls and the remainder kept loose in box stalls. The full data for each steer as to amounts of food eaten, nutrients consumed in the food, fluctuations in live weight, etc., are tabulated, and summaries are given for steers of different ages, and those loose and tied. Some of the steers were sick for awhile during the trial, which may have affected the results not a little.

The 8 steers gained in all 1,523 pounds, the gain of individuals ranging from 98 to 230 pounds. The cotton-seed meal is reckoned at $24 and the hulls at $2.50 per ton. The steers were bought at 3 and 3¼ cents per pound and sold at 3½ cents. On this basis, there was a profit of $3.89 from feeding the 8 steers, exclusive of the manure. There was a loss with 2 three-year-old steers. As between the steers tied up and those kept in box stalls there was no noticeable difference. The two-year-olds ate more food in proportion to their weight, but gave the best financial return for the food eaten. The natives fully equaled the grades in gain and in profit.

The article concludes with a discussion of the amount of water drank and its influence on the apparent live weight.

Corn silage and soja-bean silage with cotton-seed meal for beef (pp. 41, 42).—Two grade Jersey steers were fed for thirty-two days *ad libitum* on corn silage and cotton-seed meal in the proportion of 8 pounds of silage to 1 pound of meal. No. 1 ate 1,402 pounds of silage and 169.13 pounds of meal, and gained 78 pounds; and No. 2 ate 1,239 pounds of silage and 171.13 pounds of meal, and gained 85.5 pounds. They were then fed for thirty-three and thirty-six days longer on soja-bean silage in place of corn silage. No. 1 ate 1,422 pounds of silage and 184.5 pounds of meal in thirty-three days, and gained 60 pounds; and No. 2 ate 1,306 pounds of silage and 195.75 pounds of meal in thirty-six days, and gained 51 pounds. "The first ration had a most excellent effect and the second continued the gain at a rate but little slower." The ration containing soja-bean silage was much richer in protein than that of the first period and was considerably richer than called for by Wolff's standard. It is believed that the ration was too rich to secure the full value of the food.

Exclusive silage feeding, and what is a maintenance ration? (pp. 43–46).—A Jersey bull was fed on corn silage alone, or with a little cotton-seed meal, for fifteen days, after which soja-bean silage was fed alone for forty-six days. The gain in weight was from 1.75 to 1.97 pounds per day, "a remarkable gain for the food consumed."

If other trials confirm the result here given it may be stated that exclusive silage feeding can be practiced with success in growing and fattening stock as well as in maintenance if the ration is made so as to be fed in a properly balanced condition. Corn silage by itself must be fed with some other food rich in protein, or the corn must be grown with, or at least mixed with, pea vines or beans, and the two crops cut together for silage, which will not require the purchase and addition of by-fodders.

Experiments in feeding for milk and butter, A. H. WOOD (*New Hampshire Sta. Bul. No. 18, Nov., 1892, pp. 16*).—To test the effect of certain feeding stuffs on the yield and quality of milk and on the butter five lots of two cows each were fed in four periods. There were three Durhams, two Jerseys, four Ayrshires, and one Holstein. In the first period all the lots received the same ration, made up of 50 pounds of silage, 5 pounds of mixed hay, 5 pounds of oat hay, and 5 pounds of a grain mixture composed of equal parts by weight of middlings, gluten meal, and cotton-seed meal. The above ration was fed per 1,000 pounds live weight. In subsequent periods this ration was variously changed by the substitution of clover hay, vetch hay, or corn stover for a part of the coarse fodder, and of corn meal or corn-and-cob meal for a part of the grain. The data are tabulated for each lot.

As to the effect on the milk:

> With one exception, changing to clover hay not only checked the natural decrease in milk yield but gave a slight increase. * * * Again the changes from clover hay are in every case accompanied by a loss, in two instances surely beyond the natural decrease. We can safely say that clover certainly demonstrated its superiority over other hay as a supplement to silage. * * * It would seem that the mixed hay (timothy and clover) gave better results than did oat hay, although in one instance there was a gain from a change from mixed and oat hay to the oat hay alone. * * *
>
> That there are variations in the amount of fat in the milk when we compare period with period is true, but it does not follow that these variations are due to the source of the cow's food.

"No variations that can be attributed to the character of food" were shown by determinations of the casein.

Butter was made from the milk of each lot in each period, the cream being raised with a hand separator. The relative hardness of this butter was tested by the penetration of a glass rod dropped from a given height, as described in Bulletin No. 13 of the station (E. S. R., vol. III, p. 86). In two cases "the change from a heavy grain ration resulted in a much softer butter;" and in another case "the substitution of corn meal for gluten and cotton-seed meal resulted in decidedly hardening the butter. * * * Although the butter from rations containing oat hay was generally softest, it is doubtful if the whole of the variation in this instance is traceable to it."

The feeding and management of cattle, W. A. HENRY (*Wyoming Sta. Report for 1893, Appendix, pp. 37–102*).—A reprint from the special report on diseases of cattle and cattle feeding of the Bureau of Animal Industry of this Department, previously published as Bulletin No. 13 of the station (E. S. R., vol. V, p. 71).

Roots vs. silage for fattening lambs, P. M. HARWOOD and F. B. MUMFORD (*Michigan Sta. Report for 1892, pp. 247–251*).—A reprint from Bulletin No. 84 of the station (E. S. R., vol. III, p. 872).

The external conformation of the horse as related to the selection of an animal, E. A. A. GRANGE (*Michigan Sta. Report for 1892, pp. 315–321*).—A reprint from Bulletin No. 89 of the station (E. S. R., vol. IV, p. 574).

DAIRYING.

E. W. ALLEN, *Editor.*

Investigations relating to the manufacture of cheese, part III, L. L. VAN SLYKE (*New York State Sta. Bul. No. 62 (n. ser.), Dec., 1893, pp. 587–663*).—This bulletin records the work done during the season of 1893 at 48 factories in eight different counties of the State. In all 55 trials are reported, representing the milk of about 14,000 different cows. As in former bulletins of similar character the data secured, including analyses of the milk, whey, and green cheese, are fully tabulated and the results discussed and summarized. Some of the results are as follows:

Loss of milk constituents in cheese-making.—The amount of milk solids in 100 pounds of milk that was lost in the whey in cheese-making varied during the season from 6.11 to 6.49 pounds and averaged 6.28 pounds. This was equivalent to from 45.34 to 52.95 per cent of the solids in the milk, with an average of 49.92 per cent.

The per cent of the solids in the milk lost in the whey diminished as the season advanced.

The amount of fat in 100 pounds of milk that was lost in the whey in cheese-making varied during the season from 0.22 to 0.45 pound and averaged 0.34 pound. This was equivalent to from 5.95 to 11.43 per cent of the fat in the milk, with an average of 9 per cent.

The proportion of fat in milk that was lost in cheese-making was entirely independent of the amount of fat in the milk. The variations in loss were due either to the condition of the milk or to some special conditions employed in manufacture.

The amount of casein and albumen in 100 pounds of milk that was lost in the whey in cheese-making varied during the season from 0.60 to 0.88 pound and averaged 0.77 pound.

Influence of composition of milk on yield of cheese.—From 100 pounds of milk there were made during the season from 8.94 to 13.17 pounds of green cheese, the average being 10.25 pounds.

From 7.60 to 11.19 pounds of milk were required to make 1 pound of cheese, 9.76 pounds being the average.

The amount of water retained in the cheese made from 100 pounds of milk varied during the season from 3.11 to 5.78 pounds and averaged 3.85 pounds.

The amount of fat retained in the cheese made from 100 pounds of milk varied during the season from 2.94 to 4.05 pounds and averaged 3.43 pounds. The variation in the amount of fat retained in the cheese made from 100 pounds of milk followed very closely the variation of fat in 100 pounds of milk.

The amount of casein retained in the cheese made from 100 pounds of milk varied during the season from 2.12 to 2.76 pounds and averaged 2.40 pounds.

Each pound of fat produced from 2.54 to 3.06 pounds of cheese, the average for the season being nearly 2.72 pounds.

The Babcock method of determining the proportion of fat in milk and milk products (*Connecticut State Sta. Bul. No. 117, Jan., 1894, pp. 11, figs. 6*).—This bulletin is a popular description of the Babcock milk test and the method of using it, and is issued in response to frequent inquiries received at the station about this test. No new matter is reported.

AGRICULTURAL ENGINEERING.

Subirrigation vs. surface irrigation, J. W. SANBORN (*Utah Sta. Bul. No. 26, Dec., 1893, pp. 1–8*).

Synopsis—Experiments during 1890–'93 on plats of sandy loam soil seeded to grass or wheat irrigated from the surface, or from below by means of stone drains 18 inches deep or perforated cement pipes 12 feet apart and 1 foot deep, show that subirrigation by these methods failed to supply sufficient moisture for growing crops, due, it appears, to a too slow lateral movement of water in the soil; and that the soil of the subirrigated plats and the air above them were warmer than in case of the surface-irrigated plats.

The yields of grass or wheat during 1890–'93 and data relating to moisture content of the soil and the temperature of the air and soil on the different plats are tabulated and discussed. "To ascertain the rate of lateral movement of water after it was first turned into the pipes, a trench was dug at right angles to the receiving pipe, and the rate of movement of water from the pipe measured in inches at different dates. * * * After pressing out from the pipe for the first 3 or 4 feet or so the progress [of the water] for an entire day is measured by a very few inches. * * * In a short time, or after passing a few feet from the pipe, evaporation soon equals the percolation and it reaches a point where the water would not supply even the most moderate growth."

From the results obtained the following conclusions are drawn:

(1) Subirrigation, whether by large open drains or by the cement-pipe system, fails to supply moisture enough for growing crops.

(2) The lateral movement of water was too slow to furnish the requisite supply for the evaporation of plants, being at the rate of a very few inches per day.

(3) The subirrigated soil was warmer than the surface-irrigated soil.

(4) The atmosphere around the plants, to the height of 12 inches, was warmer by subirrigation than by surface irrigation.

(5) The subirrigated plat did not contain as much moisture as the surface-irrigated plat.

(6) It is concluded that for the college farm the lateral movement of water can not be made rapid enough for maximum crop growth.

(7) The system is too costly for ordinary farm crops.

Water for irrigation, S. FORTIER (*Utah Sta. Bul. No. 26, Dec., 1893, pp. 9–28*).—This is a report of observations in different parts of Utah during the period from June 8 to September 2, 1893, on (1) duty of water, (2) waste of water, and (3) available water supply.

In Utah less than 1 per cent of the entire area is irrigated. The available water supply, with a few exceptions, has been appropriated, hence the future advancement of irrigation chiefly depends upon a more economical use of water. That a much higher service can be obtained is evident from the figures given in the next few pages. In many localities a miner's inch, or one fiftieth of a second-foot (cubic foot per second), is considered necessary for 1 acre, whereas in southern California the same quantity irrigates on an average 8 acres. There is, therefore, much to be hoped for as regards irrigation in Utah. By storing a small percentage of the surplus flow, by

preventing loss in transmission, and by a more economical use, it is believed there is water enough available to water all of the valley lands.

Duty of water (pp. 10–15).—The results of observations on ten different farms on the depth of water supplied and the acreage irrigated per second-foot, calculated on the basis of one hundred days, are summarized in the following table:

Duty of water on 10 farms in Utah.

Number.	Kind of crop.	Water supplied (in inches).	Duty of water (in acres per second-foot).	Produce per acre.
1	Strawberries	5.25	566	
2	Cauliflower	8.25	291	7½ tons.
3	Tomatoes	24.75	97	10 tons.
4	Mixed crop	23.00	103	
5	Barley	7.25	330	55⅓ bushels.
6	Corn	3.75	660	30 bushels.
7	Potatoes	16.62	143	423 bushels.
8	Onions	35.50	67	19½ tons.
9	Strawberries	27.50	93	300 cases.
10	Peach orchard	12.00	213	No record.
	Mean	16.40	256	

The rainfall for June, July, and August of 1893 in the northern part of the Territory, was only one fourth of an inch. This indicates an extremely dry season. The average depth of water, including rainfall, spread over the surface in the ten fields tested, was 16.4 inches. In an average season the rainfall during the irrigating period might be 3 or more inches, which would limit the use of irrigated water to nearly 1 foot in depth—a highly creditable result.

Waste of water (pp. 16–22).—The result of observations on nine creeks and canals used for irrigation purposes show a wide variation in the loss of water in transmission, being 6.7 per cent in 5 miles in case of the Bear River Canal and 100 per cent in three fourths mile in case of Taylor Creek flowing through "a rugged canyon, more or less filled along the bottom with coarse gravel, rock, and boulders."

The available water supply (pp. 22–28).—Observations by the author and F. H. Newell, of the U. S. Geological Survey, on the flow of water at different times in thirty-five of the canals, creeks, and rivers in seven of the counties of the Territory are tabulated.

STATION STATISTICS.

Report of director of Michigan Station (*Michigan Sta. Report for 1892, pp. 168–171*).—A brief survey of the work of the year, with a list of the bulletins published by the station.

Report of treasurer of Michigan Station (*Michigan Sta. Report for 1892, pp. 172–174*).—This is for the fiscal year ending June 30, 1892.

Seventh Annual Report of Nebraska Station (*Nebraska Sta. Report for 1893, pp. 40*).—This includes a brief survey of the work of

the year, a list of the bulletins published, a treasurer's report for the fiscal year ending June 30, 1893, and a list of books and periodicals in the station libraries.

Annual Report of Wyoming Station (*Wyoming Sta. Report for 1893, pp, 254*).—This includes brief reports by the director, horticulturist and meteorologist, physicist, botanist, entomologist, chemist, geologist, and the superintendents of each of the six experiment farms; a treasurer's report for the fiscal year ending June 30, 1893: and reprints of the bulletins issued during the year, which are noticed elsewhere.

ABSTRACTS OF PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE.

A revision of the adult cestodes of cattle, sheep, and allied animals, C. W. STILES and A. HASSALL (*Bureau of Animal Industry, Bul. No. 4, Sept., 1893, pp. 104, plates 16*).—This is a scientific classification and description of the different species of tapeworms found in cattle, sheep, and allied animals.

It has long been known that herbivorous animals were subject to infection by tapeworms, but it was not known exactly how many different species were to be found, nor has it heretofore been definitely known what particular species were present in America. Since it may be assumed that every separate species of tapeworm found in animals has a separate source of infection, it has been deemed important to obtain definite data for the determination of the various species already described and to give descriptions of the new forms found in this country. With this end in view, the original type specimens of European species were restudied according to the more modern scientific methods before the American forms were investigated. The manuscript herewith transmitted covers the results of a more thorough and extensive study of the tapeworms of cattle and sheep than has ever before been attempted, and places the forms mentioned on a scientific foundation.

The work is illustrated by sixteen finely executed plates.

A contribution to the investigation of the assimilation of free atmospheric nitrogen by white and black mustard, J. P. LOTSY (*Office of Experiment Stations, Bul. No. 18, pp. 19, figs. 15*).—The author reviews the literature of the investigations on the assimilation of free atmospheric nitrogen by white and black mustard and reports experiments made during the season of 1893 by himself at Johns Hopkins University.

Investigations by Frank and Liebscher had indicated that these plants were able to assimilate appreciable quantities of free atmospheric nitrogen, even when nitrates were not present in the soil. In the opinion of the author, the results were not conclusive and needed further confirmation. Accordingly, black and white mustard were each grown in sand cultures and water cultures, with and without nitrates. "All plants which received fixed nitrogen were normally and completely developed both in sand and in water cultures. Of those which got no nitrogen, all in water cultures died, while the sand cultures of *Sinapis alba* did not show any more development than could be explained by the nitrogen contained in the seed. The sand cultures of *Sinapis nigra*, however, developed so far as to indicate an assimilation of free nitrogen."

To determine whether the results in sand and in water cultures were due to the plants themselves, or whether microörganisms played a rôle, sterilized sand and water cultures were made, growing both black and white mustard in cultures with and without the application of nitrates. The materials used were all sterilized before beginning the experiment, and the cultures were kept sterilized during the whole time. In each case the plants receiving nitrates grew well and developed, but those receiving no nitrates died very soon after planting.

From the results of these experiments the author concludes that black and white mustard do not assimilate the free nitrogen of the atmosphere in the absence of fixed nitrogen.

Report of the Chief of the Weather Bureau, 1891–'92 (*Weather Bureau, Report for 1891–'92, pp. 528, diagrams 4, figs. 23*).—"There will be found in this, the initial volume of meteorological data published by the Weather Bureau, the results of observations made during 1891 and 1892—continuing the series heretofore published by the War Department—and other climatological tables of general interest and importance in connection with the current work of the Bureau."

The volume is divided into six parts. Part I includes an introduction by the Chief of the Bureau, a list of observing stations, an illustrated description of instruments by C. F. Marvin, and instrumental corrections, methods of reduction, resulting accuracy, by C. Abbe; part II, monthly averages of temperature, pressure, and wind movement for each hour of the day at 28 stations; part III, monthly and annual meteorological summaries for Weather Bureau stations; part IV, monthly and annual mean temperatures, annual extremes of temperatures, and dates of first and last killing frosts, 1891–'92; part V, monthly and annual precipitation at all stations; and part VI, miscellaneous meteorological tables and reports, comprising normals for temperature, pressure, and precipitation, snowfall and sunshine, 1891–'92, river stages, local storms in the United States during 1890–'92, by H. A. Hazen; casualties due to lightning, by A. McAdie; an account of a balloon ascension, by H. A. Hazen; reports on the relations of solar magnetism to terrestrial magnetism and meteorology, by F. H. Bigelow; and an article on the condensation of atmospheric moisture, by C. Barus.

ABSTRACTS OF REPORTS OF FOREIGN INVESTIGATIONS.

The volatility of pyrophosphoric acid, G. WATSON (*Chem. News, 68 (1893), No. 1770, pp. 199, 200*).—From observations on orthophosphoric acid heated at temperatures of from 215° to 300° C., the author concludes that:

"(1) Orthophosphoric acid is not completely dehydrated into pyrophosphoric acid at temperatures below 230° to 235° C.

"(2) Orthophosphoric acid is completely converted into the 'pyro' modification at a temperature of 255° to 260° C., the pyrophosphoric acid being volatile at the same temperatures. Hence it is probable that the temperatures of complete formation and of volatility may be identical, in which case orthophosphoric acid will be analogous to orthoboric acid, which is dehydrated into metaboric acid and slowly volatilized at a temperature of 100° C.

"(3) Metaphoshoric acid is on the verge of formation at temperatures about 290° to 300° C."—W. H. B.

The influence of lime and salts, as well as certain acids, on the flocculation of clay, R. SACHSSE and A. BECKER (*Landw. Vers. Stat., 43 (1893), No. 1 and 2, pp. 15–25*).—This is an account of experiments with limewater, gypsum, sulphate of magnesia, sulphate of ammonia, chlorides of potassium, sodium, and ammonium, and carbonic, hydrochloric, sulphuric, nitric, and silicic acids upon nearly pure Carlsbad kaolin containing 99.5 per cent of particles finer than 0.01 mm. in diameter, ground silica, and two natural soils—one a heavy clay loam, the other a humus alluvial loam.

It was found that 0.009 gram of CaO in 250 c. c. of water was sufficient to flocculate the 0.187 gram of kaolin which remained suspended in 250 c. c. of water, and it appreared that the flocculation of the kaolin was not the result of a chemical combination with lime. Of the two soils the clay loam flocculated readily on the addition of limewater, but the humus loam was precipitated with difficulty and absorbed a large amount of lime. This appeared to be due to its high content of humus.

The kaolin and the two soils were each shaken up with pure water and with limewater and the soil particles afterward separated by Schöne's method. The proportion of coarser particles was very decidedly increased by this treatment in case of the kaolin and of the clay soil, but not very materially affected in case of the humus loam.

In order to observe the effect of applications of lime upon the percolation of water in kaolin and in the clay loam soil, a weighed amount of each substance was mixed with 2 per cent of caustic lime and placed in wide glass tubes. Similar tubes were filled with like amounts of untreated material. A measured quantity of water was then poured upon each and the rate of percolation observed. In case of the clay loam treated with lime the water reached the bottom of the tube in one hour and ten minutes. Of the 61.2 c. c. of water used 22.5 was recovered by percolation. In case of the untreated soil no water passed through. With kaolin similar results were obtained. Where lime was used the water reached the bottom of the tube in one hour and fifty minutes, and of the 40 c. c. added 19 was recovered by percolation. Where no lime was used only a few drops of turbid water percolated through, and the swelling of the kaolin particles finally broke the tube.

Carbonic acid was also found to flocculate the kaolin and the clay soil readily, but was without action on the humus loam. The mineral acids—hydrochloric, sulphuric, and nitric—were also found to possess the same property, the first being especially active. In comparative trials with limewater it proved more effective than the latter in flocculating both the kaolin and the two soils above described. Gypsum, sulphate of magnesia, and sulphate of ammonia were found to possess the power of flocculation to some extent, but were not very effective agents for this purpose. Monocalcium phosphate exhibited the power in a marked degree. The chlorides of potash, ammonium, and soda flocculated the kaolin and the clay soils, but were without effect on the humus loam. Phosphate of potash, KH_2PO_4, gave negative results.

Experiments with nitrate of soda showed that this salt not only prevented flocculation but also separated floccules that had already been formed. It is explained that this result may be in part due to the formation of carbonate of soda in the soil, which acts upon the hydrated silicates of the soil, producing colloidal silicates which reduce the permeability of the soil to water.

Experiments were also carried out with silicic acid in the form of siliceous earth and powdered quartz suspended in water. These behaved toward the flocculating agents in much the same manner as kaolin, except that it was observed that the quartz meal was flocculated with more difficulty than the siliceous earth. A mixture of powdered quartz and kaolin suspended in water was treated with carbonic acid. The kaolin was precipitated at once, while the quartz powder remained suspended. It is thought that this may explain the behavior already noted of the alluvial loam soil toward carbonic acid.—W. H. B.

The detection of adulteration of ground Thomas slag, E. WRAMPELMEYER (*Landw. Vers. Stat., 43 (1893), No. 1 and 2, pp. 183–190*).—The author studied the reaction and qualities of Osso, Lütticher, Cambresis, Somme, Malogne, and Redonda phosphates, and of ground copro-

lite and "craie grise" as compared with various samples of new and old ground Thomas slag.* The test applied in each case were microscopic examination, loss on ignition, "volume weight," solubility in warm water, and percentages of total and citrate-soluble phosphoric acid. From the results of these studies he concludes that in the majority of cases the genuineness of ground Thomas slag can be determined from the microscopic examination and the volume weight. He recommends the determination of the volume weight in preference to the specific gravity. This is the weight in air of 1 c. c. of material, and is found from the weights of a glass vessel of known volume (8 to 10 c. c.) when empty and when filled with the material. Determinations of the volume weight by different persons are said to give results agreeing very closely. The microscopic examination should never be omitted, and if the results of this throw suspicion on the sample the volume weight and the loss on ignition should be determined. For the samples of Thomas slag examined the loss on ignition did not exceed 4.3 per cent, and the volume weight did not fall below 1.6730 and was usually above 2. The solubility in hot water may also be determined. This is done by boiling 2 grams of ignited material with water, washing the residue on a filter with hot water until the washings are no longer alkaline and leave no residue on evaporation, and then incinerating the filter and weighing the residue, making allowance for the loss on ignition. These figures were quite different from those found for the other materials examined. If the loss on ignition is low and the volume weight and proportion soluble in hot water high, no further tests are deemed necessary. In case these are doubtful it is recommended to determine the citrate-soluble phosphoric acid by either the Loges or Petermann method.—E. W. A.

The injurious effect of nickel salts on plants, E. HASELHOFF (*Landw. Jahrb., 22 (1893), No. 6, pp. 862–867*).—The waste water from some nickel ore crushing works having been the cause of serious complaints from farmers whose lands bordered upon the stream carrying the waste, it was determined to ascertain the effect of nickel on plants. Analyses showed the undoubted presence of copper, zinc, and nickel in the soil; and, as the effect of the first two was known, that of the nickel only remained to be determined.

During the summer of 1890 the author tested by means of a series of water cultures the effect exerted by nickel on horse beans and corn. The usual methods of water cultures were followed. In the case of those plants not furnished with any nickel in their nutrient solutions the growth and development were normal, while all of those receiving the same nutrient material to which a quantity of nickel was added were sooner or later injuriously affected. In making the solutions nickel sulphate was used, 1 c. c. of the solution representing 1 mg. of nickel oxide. The author tested in the water cultures the effect of 2.5, 5, 7.5, 10, and 50 mg. of nickel oxide to each liter of nutrient

solution. The experiments with the horse bean were continued for fifty days. Those plants grown in the solutions containing nickel soon turned spotted, became yellow, the flowers fell off, and on the whole their condition was very unsatisfactory. All died in from twelve to fifty days. Upon corn the effect was very similar to that upon the beans, and at the end of seventy-two days all plants treated with nickel oxide were dead, while the check plants were still sound and growing. From these experiments the effect of nickel salts upon the growth of plants is shown to be very injurious, no matter how small the quantity.—W. H. E.

Experiments on the replacement of lime by strontium in plant nutrition, E. HASELHOFF (*Landw. Jahrb., 22 (1893), No. 6, pp. 851–867*).—The experiments of Papillon* and J. König† have indicated that strontium may to a certain extent replace lime in the food of animals, but whether it can do so in the nutrition of plants has not heretofore been investigated.

The experiments here reported were of two kinds—(1) with barley and beans in Wagner vegetation boxes, and (2) with horse beans and corn in water cultures.

In the first series a soil was used which contained, besides other fertilizing elements, 0.53 per cent of lime soluble in hydrochloric acid. To this soil was added in different cases 2 per cent of calcium carbonate or 2 per cent of strontium carbonate, besides a complete fertilizer consisting of superphosphate, nitrate of soda, and kainit. The boxes receiving no addition of calcium or strontium carbonate gave a slightly higher yield of both barley and beans than those receiving applications; the differences, however, were small. The ash of plants grown on soil supplied with strontium carbonate showed the presence of a trace of strontium.

The water cultures were carried out in the usual way, except that in some cases the calcium nitrate of the culture solution was partially or wholly replaced by strontium nitrate. From the results it appears that the solutions containing strontium had no injurious effects on the plants. Analysis of the ash indicated that in case of the corn at least an increase of strontium in the culture solution was accompanied by a decrease of calcium and an increase of strontium and potash in the ash.

From these experiments the author draws the following general conclusions: (1) Strontium does not injuriously affect the growth of plants; (2) it is taken up by plants and appears to take the place of lime as a plant food; (3) this replacement of lime by strontium appears, however, to occur only when there is not a sufficient supply of lime and other elements for the building up of the plant organism.—W. H. B.

Are there conditions under which fertilizing with nitrate of soda may diminish the nitrogen content of soils? P. HELLSTRÖM

* Compt. Rend., 71 (1870), p. 372.
† Landw. Jahrb., 3 (1874), p. 421.

(*Landw. Vers. Stat., 43 (1893), No. 1 and 2, pp. 127–141*).—The author asserts that this is still an open question, notwithstanding the positive assertion of Wagner in a recent work* that a soil fertilized with nitrogen (not in excess) may be poorer in soluble nitrogen after the growth of a crop than one not fertilized with nitrogen. He reviews the experimental data on which this proposition rests and intimates that they need further confirmation.—W. H. B.

The value of lupines, serradella, crimson clover, and hairy vetch as plants for green manuring, BAESSLER (*Wochenschr. pom. ökon. Ges., 1893, No. 18, pp. 227–231; No. 19, pp. 242–244*).—For the cultivation of leguminous crops to be used as green manures the author selected a field with a humus sandy soil, near Regenwald, Germany. A long rectangular piece of land of uniform appearance was divided into 22 plats, each 50 square meters in area. On each plat 200 pounds of kainit and 120 pounds of ground Thomas slag per acre were applied and turned under April 18. Yellow, white, and blue lupines, serradella, hairy vetch (*Vicia villosa*), and crimson clover were sown broadcast on separate plats May 15, and 4 plats fertilized like the others were left bare. The rate of seeding was for lupines 52 pounds of seed per acre, for serradella 9 pounds, for vetch 18 pounds, and for crimson clover 4.5 pounds. The vetch seed was mixed with about one third of its weight of rye, so that the rye plants might act as supports for the vetch vines.

The lupines were harvested at four different stages of growth: (1) July 13, when flowers appeared on the main axis; (2) August 19, when flowers appeared on the lateral branches; (3) September 11, when pods appeared on the main axis, and (4) September 28, when pods appeared on the lateral branches. Serradella was harvested September 11, when in bloom, and September 28, when past the blooming stage. At the latter date crimson clover and hairy vetch, the blooming time of both having long since passed, were harvested.

The lupine plants were pulled and the dirt adhering to the roots carefully removed. Naturally only the stronger parts of the roots, averaging about 10 inches in length, were thus secured, while the weaker portions were left in the soil. As soon as 200 to 300 plants were drawn they were weighed, and the weights of roots, stems, leaves, blooms, and pods for 10 to 15 average plants were determined. The figures for hairy vetch do not include the roots, but embrace a small amount of grainless rye grown with vetch.

The stand of lupines was thin, but a rainy season caused some lodging on most of the plats. In the early stages of growth serradella and crimson clover showed a rather unsatisfactory stand, but later their appearance improved. Serradella attained a length of 48 inches and crimson clover 37 inches. Rye was overgrown by vetches, the growth of which was luxuriant. At harvest time, September 28, the vetches

*Die Stickstoffdüngung der landwirthschaftlichen Kulturpflanzen.

had become in large part brown and dry, only the tips showing a green color. The vines attained a length of 88 inches.

The percentage of nitrogen in the dry matter of the roots and stems of lupines decreased in general with the increasing age of the plant; this decrease was less marked with the leaves.

Yellow lupines dropped but few leaves between September 11 and September 28, and with this variety the total quantity of green forage and of organic matter per acre increased with the age of the plant. With white and blue lupines, in which the loss of leaves was greater, the maximum figures for green forage and organic matter were reached September 11. With all plants the nitrogen was greatest September 11.

The number of lupine plants harvested on each plat of 50 square meters ranged between 3,520 and 5,095. The average amounts of nitrogen per plant in yellow, blue, and white lupine at different dates was as follows:

Average amount of nitrogen per plant in lupines at different dates.

	July 31.	Aug. 19.	Sept. 11.	Sept. 28.
	Gram.	*Gram.*	*Gram.*	*Gram.*
Yellow lupine	0.160	0.194	0.332	0.300
Blue lupine	0.169	0.236	0.266	0.240
White lupine	0.207	0.290	0.295	0.247

Yellow lupines led all other plants in the amount of green forage, 56,672 pounds per acre; of organic matter, 8,054 pounds; and of nitrogen, 227 pounds. White lupines, followed by blue lupines, came next. Serradella afforded more organic matter than hairy vetch or crimson clover. Of the last three, hairy vetch (exclusive of roots) gave the largest amount of nitrogen, 127 pounds per acre, and the smallest amount of organic matter. Of the six plants crimson clover contained least nitrogen, 76 pounds per acre.

As soon as cut and weighed each green-manuring crop was carefully spread out and turned under on the plat where it had grown. Probsteier rye was sown as an aftercrop to determine the actual fertilizing effects of the six leguminous crops. It was sown October 11, shortly after the last of the green crops had been turned under. The appearance of the rye the following spring indicated greater differences due to the different dates at which the green crops were turned under than to the different kinds of crops. The rye was cut July 28.

The average yield on the four plats without green manure was 916 pounds of grain and 1,711 pounds of straw per acre. The following table gives the weight of 1,000 grains of rye from plats differently treated in the preceding year, and the increase of grain and straw per acre for the green-manured plats over the average yields of the four unfertilized plats:

Increase in the yield of rye per acre on green-manured plats over those not green manured.

Kind of green manure.	Date when plowed under.	Weight of 1,000 kernels of rye.	Increase in grain.	Increase in straw.
		Grams.	*Pounds.*	*Pounds.*
Yellow lupine	July 31	24.755	* −50	−240
Do	Aug. 19	24.875	230	39
Do	Sept. 11	25.638	569	504
Do	Sept. 28	26.490	1,101	1,261
Blue lupine	July 31	26.402	568	764
Do	Aug. 19	26.646	729	989
Do	Sept. 11	27.125	1,149	1,808
Do	Sept. 28	26.930	1,343	1,963
White lupine	July 31	27.078	130	300
Do	Aug. 19	26.935	580	606
Do	Sept. 11	27.020	953	1,480
Do	Sept. 28	27.545	1,352	2,137
Serradella	Sept. 11	26.450	645	912
Do	Sept. 28	26.668	1,241	1,845
Crimson clover	Sept. 28	26.910	830	1,403
Do	Sept. 28	27.170	903	1,620
Vetch	Sept. 28	26.858	726	1,314
Do	Sept. 28	26.668	1,077	2,122

* Loss.

The effect of green crops plowed under late was shown in a large increase in the yield of the following crop of rye. The author recommends that plants for green manuring be plowed under as late as possible in the life of the plants, and that turning them under in the hot months long before the succeeding crop occupies the land be avoided as far as possible.—J. F. D.

Melilotus as green manure for heavy soils, ORTH (*Braunschw. landw. Ztg., 60 (1892), No. 38, p. 160*).—Near Tost, Germany, an experiment was conducted to test the effect of green manuring with *Melilotus alba* on the succeeding crops of barley, oats, and potatoes. In the early part of May, 1889, melilotus seed, at the rate of 21 pounds per acre, was sown in rye. The rye had been preceded by wheat, and the wheat by rape. The green melilotus was plowed under to a depth of 10 inches in the summer of 1890.

On oats grown after melilotus the results were as follows:

Yield of oats and straw per acre with different manuring.

Treatment.	Grain.	Straw.
	Pounds.	*Pounds.*
Without green manuring, no fertilizer	1,099	1,748
Green manuring, no fertilizer	1,645	3,381
Green manuring, 322 pounds Thomas slag	1,901	3,186
Without green manuring, 161 pounds nitrate of soda (harrowed in)	2,723	5,003
Without green manuring, 161 pounds nitrate of soda (as top-dressing)	1,591	3,455

On potatoes, the results of green manuring with and without stable manure and commercial fertilizers were as follows:

Yields of potatoes per acre with different manuring.

	Pounds.
Without green manuring	6,923
Without green manuring, 8 tons stable manure	12,236
Green manuring, no fertilizer	14,490
Green manuring, 161 pounds nitrate of soda	16,100
Green manuring, 322 pounds Thomas slag	21,735
Green manuring, humus soil	13,685
Green manuring, humus soil and 322 pounds Thomas slag	17,549
Green manuring, 4 tons stable manure	20,930
Green manuring, 8 tons stable manure	24,311

Green manuring with melilotus increased the growth of maize, but the detailed results are not given. The experimenter recommends that 24 pounds of clean melilotus seed per acre be sown, and that the seeding take place in spring as soon as the snow melts.—J. F. D.

Comparative tests of the fertilizing effects of various phosphates, O. KELLNER, Y. KOZAI, Y. MORI, and M. NAGAOKA (*Landw. Vers. Stat., 43 (1893), No. 1 and 2, pp. 1–14*).—This is an account of experiments with phosphates reported in Bulletin No. 12 of the College of Agriculture, Tokio, Japan (E. S. R., vol. IV, p. 861).—W. H. B.

Fertilizer experiments on barley and oats in connection with chemical analysis of the soil, VON LIEBENBERG and E. VON PROSKOWETZ (*Mitt. Ver. Förd. landw. Versuchsw. Oesterreich, 1893, No. 8, part 1, pp. 3–41*).—These are in continuation of a series of coöperative experiments which have been carried out during a number of years under the auspices of the Society for Promoting Agricultural Research in Austria, and include (1) experiments with orthophosphoric acid on barley on seven farms and on oats on six farms; (2) with liquid fertilizers on barley on three farms and on oats on six farms; and (3) with steamed ground bone on wheat on four farms; with a general review of the relation of the chemical properties of the soil to the results of the field experiments.

Experiments with orthophosphoric acid (pp. 3–13).—In these experiments four plats remained unmanured; three seeded to barley received 150 kg. of nitrate of soda per hectare, and three seeded to oats 250 kg.; three plats received the same amounts of nitrate of soda and 50 kg. of phosphoric acid in the form of ground bone superphosphate or monocalcium phosphate; and three plats received the above amounts of nitrate of soda and 50 kg. of phosphoric acid in the form of orthophosphoric acid. The solution of orthophosphoric acid was diluted with 20 to 30 liters of water per are (119.6 square yards) and applied uniformly over the plats with a fine-nozzle sprinkler. The results confirm previous conclusions that nitrate of soda is more profitable than phosphoric acid. The action of the latter, however, depends largely upon the lime content of the soil on which it is applied. The results here reported confirm the observation of Stoklasa that orthophosphoric acid is more effective in increasing the yield on calcareous soils and the water-soluble phosphoric acid in monocalcium phosphate on loam soils.

Experiments with liquid fertilizers (pp. 14–20).—The plan of this experiment and the amounts of fertilizers used were the same as in those with orthophosphoric acid, except that the phosphoric acid was supplied in the form of boneblack superphosphate, and in case of 3 plats the nitrate of soda and boneblack superphosphate were dissolved in water at the rate of 40 to 50 liters per are and sprayed over the plats. As in the first series of experiments phosphoric acid produced little effect, while nitrate of soda considerably increased the yield. No benefit was derived from applying the fertilizers in solution.

Experiments with steamed ground bone (pp. 21–25).—These experiments were conducted on about the same plan as those already described, phosphoric acid being supplied in the form of steamed ground bone, containing 17.6 per cent of phosphoric acid, 4.5 per cent of nitrogen, and 2.5 per cent of fat, and of ground bone superphosphate containing 18.6 per cent of water-soluble phosphoric acid and 4.5 per cent of nitrogen. From the results it appears that there was no difference in effect between the two phosphates.

Chemical analysis of the soil in its relation to the above fertilizer experiments (pp. 26–41).—In the study of this subject samples of the soils and subsoils experimented on in the above tests were collected and analyzed. The results of analysis serve to explain those of the fertilizer experiments, especially as regards the action of phosphatic and nitrogenous fertilizers.

A study of the detailed tabulated data shows that the yield depends not only upon an adequate supply of plant food in the soil, but especially upon the relation of nitrogen to phosphoric acid, the yield being higher the greater the proportion of nitrogen present; and that on soils of low fertility the yield is better the wider this ratio. Calculating the ratio of phosphoric acid to nitrogen in the soil for the first five and last five experiments with barley, we have 1:1.5 and 1:1.11. Similar figures for the first six and last six experiments with oats are 1:1.45 and 1:1.11.

It is of special interest in this connection to compare the relation of nitrogen to phosphoric acid in the soil and in the crop. With barley the average of all experiments is as follows: In the surface soil N: P_2O_5:: 1.33: 1; in the crop unfertilized plat on, 2.52: 1; draft on soil supply, 2.62: 1. With oats the corresponding figures are 1.28: 1, 2.91: 1, and 2.45: 1. It appears from these figures that the ratio of nitrogen to phosphoric acid is much greater in the crop than in the soil, and that the supply of nitrogen in the soil is drawn upon much more largely than that of phosphoric acid. They clearly explain the observed fact that manuring with nitrogen almost always increased the yield, and that manuring with phosphoric acid produced good results only when used in connection with nitrogen.

From a review of all the experiments it appears that as observed in previous years all the soils were benefited more or less by nitrate of soda, and that the action of phosphoric acid began to be impaired as

soon as the supply in the surface soil reached 38 to 40 metercentners per hectare (3,142 to 3,563 pounds per acre).

The effect of the various fertilizers on the physical qualities of the grain produced was also observed and the results are recorded, but no very marked variation of quality was noted in the grain from the different plats.

The general conclusion drawn from all these experiments is that under the influence of the climate of Austria the use of phosphatic fertilizers on cereals is as a rule unprofitable, but that the use of nitrate of soda in moderate quantities will generally be found remunerative. —W. H. B.

Field experiments with fertilizers in Great Britain in 1891 (*Report of Board of Agriculture on Grants for Agricultural Education for 1891–'92, pp. 21–76*).—This is an account of experiments aided by the Board of Agriculture and carried out at different places in England, Scotland, and Wales, in most cases under the supervision of the local agricultural societies. They include experiments with fertilizers on barley, wheat, mangel-wurzels, ruta-bagas and turnips, grasses and pasture lands, potatoes, and cabbages; observations on the value of potash for chalk soils and salt for barley, and on the unexhausted residue of manures.

Barley experiments (pp. 21–24, 44).—The results of five years' experiments carried on under the supervision of the Norfolk Chamber of Agriculture are summarized and discussed. The principal results are given below:

Barley always and inevitably wants nitrogen, and frequently, but in a less degree, is improved in yield by phosphates or potash or both in addition to the nitrogen. * * * The most soluble form is usually the most effective, and further, the most soluble form in which such manure can be bought is usually the most economical one to use. * * * It is economical as well as safe and wise to give nitrate of soda to the amount required for a full, but not overluxuriant, crop for the land on which it is used.

From 100 to 200 pounds per acre of nitrate of soda with 200 pounds of superphosphate, and where required, from 50 to 100 pounds of muriate of potash in addition, is recommended. As regards the time and method of applying fertilizers, the observation is made that—

[Mineral manures] can scarcely be sown too soon, and it needs only that care be taken to sow them soon enough that they may be well dissolved and incorporated with the soil before the roots of plants require them. On the other hand, ammoniacal and nitrogenous manures of the more soluble kind, such as sulphate of ammonia and nitrate of soda, are very readily washed away and therefore should not be sown too soon. * * * Nitrogenous top-dressings are perhaps sown in safest season when the young plant is just showing itself above ground, or, if a larger dose is to be given, a portion may be withheld for a fortnight or so after that.

Wheat experiments (pp. 24–30, 45).—This is a summary of three years' experiments on three different farms in the same series as the above. Three classes of soil were represented in these experiments: (1) thin,

light soil, frequently with chalk subsoil; (2) deep, fertile loam; (3) chalk soils. The following practical conclusions regarding the fertilizing of wheat are drawn from the experiments:

Upon light or mixed soils, after grass and where it is available, 10 loads per acre of barnyard manure, plowed in in the autumn, with from 25 to 100 pounds of nitrate of soda, sown in the spring, is perhaps the best dressing, omitting the nitrate of soda where experience shows a maximum crop for the land can be obtained without it, or upon dark and other soils too liable to mildew to allow of top-dressing in safety.

After a good crop of clover, or where an appreciable second crop of seeds is plowed in for the wheat, with, in either case, previous good farming, the barnyard manure alone should be enough for the wheat.

When barnyard manure is not available for the wheat, the most effective and economical substitute is 400 pounds per acre of rape cake plowed in in the autumn, or, when the cake is dearer in proportion, 100 pounds per acre of sulphate of ammonia sown in the spring, with, in either case, 100 pounds per acre of nitrate of soda as a spring top-dressing; and in addition to the above, on land in doubtful agricultural condition, or exceptionally deficient in either ingredient, add 200 pounds per acre of superphosphate or 100 pounds of muriate of potash, or both of these manures plowed or harrowed in in the autumn.

Experiments on mangel-wurzels (pp. 30, 31, 45, 53, 64).—Experiments on typical Norfolk soils during a number of years give the following suggestions regarding the proper manuring for this crop:

Upon almost any Norfolk soil it would be difficult to improve, for economy and effectiveness, upon a mixture consisting of 200 pounds of nitrate of soda, 300 pounds of common salt, and 200 pounds of superphosphate. Upon certain soils peculiarly adapted to mangel-wurzels, and in warmer localities where larger crops of 25 to 30 tons per acre are habitually grown, it would probably pay to increase or to double the above quantity of soda.

Ten loads per acre of barnyard manure may, if preferred, be substituted for all or a part of the nitrate of soda, or may even be used in addition to it, according to the resources of the farmer in respect of it, and the return he desires to get from the dung in the first year of application or in future ones.

In point of economy, however, when considered solely as a manure for the mangel-wurzels, the dung dressing, as compared with the nitrate of soda, has very little to recommend it. When 200 pounds or more of nitrate of soda are used it is better to sow half the quantity at time of seeding, and the other half as a top-dressing, immediately after the first hand hoeing of the roots; if only 100 pounds of nitrate of soda are sown with the dung, then all of it as a top-dressing.

Experiments under the auspices of the Bath and West and Southern Counties Society, having as an object "to ascertain what manures can be most advantageously used for the production of a good crop of mangel-wurzels, having regard also to their effect upon the succeeding crop of corn," led to the following conclusions in 1890, which were confirmed in similar experiments during 1891:

(1) Both in larger produce of mangel-wurzels as well as in smaller cost the plats without dung have the advantage.

(2) The addition of mineral superphosphate alone to a full quantity of dung (20 loads per acre) has given a slight advantage.

(3) Half the quantity of dung with 200 pounds nitrate of soda added has given a better result than a full dressing of dung.

(4) The further addition of mineral superphosphate and of salt has in each case given an increase of crop.

(5) The addition of mineral superphosphate and salt to 400 pounds nitrate of soda and of mineral superphosphate (without salt) have each produced heavier crops than 400 pounds nitrate of soda alone.

(6) Three hundred pounds sulphate of ammonia has not done so well as 400 pounds nitrate of soda, each having the same addition of mineral superphosphate.

A further addition, however, of 100 pounds sulphate of potash to the sulphate of ammonia and mineral superphosphate has produced an increase of about 1 ton per acre.

Experiments under the direction of the University College of North Wales, Bangor, "show that this crop should have a dressing of barnyard manure, supplemented by a nitrogenous manure such as nitrate of soda, a phosphatic manure such as superphosphate or basic slag, a potash manure such as kainit, and, in addition, a few hundredweights of salt per acre."

Experiments during five years, under the supervision of the Essex Agricultural Society, lead to the following conclusions:

The most useful artificial manure for increasing the mangel-wurzel crop is nitrate of soda, used with phosphatic manure. If no dung is used not less than 400 pounds per acre of nitrate should be used. If 10 or 12 tons of dung are used about 300 pounds of nitrate will generally be found sufficient, but in some years it pays to use even 400 pounds with dung; 100 pounds of nitrate should be sown with the seed, 100 pounds top-dressed after singling out, 100 pounds top-dressed a month to six weeks later, and, at discretion, a fourth 100 pounds a month to six weeks later still. Salt, which in the Bath and West of England Society's experiments has proved a decidedly useful addition to nitrate of soda for mangel-wurzels, has not been found to be of any use on this land, nor has potash.

To obtain the best results, and to maintain the condition of the land, phosphatic manure should also be used, when, as we recommend, as little dung as 10 or 12 tons is used. * * *

There is no fear of impoverishing the soil by the growth of heavy mangel-wurzel crops with large dressings of artificial manures.

Ruta-baga experiments (pp. 31–35, 46, 58).—This is a summary of experiments, during five years, by the Norfolk Chamber of Agriculture, on chalk soil, deep loam, and light soil. Practical directions for manuring ruta-bagas drawn from these experiments are as follows:

Three hundred to 400 pounds per acre of superphosphates, 100 pounds of sulphate of ammonia, and 50 pounds of muriate of potash is an admirably complete and economical dressing for general use; although occasionally it may be found advisable to reduce the quantity of sulphate of ammonia, or to leave it out altogether; and in other cases the potash may be judiciously omitted. Excess of nitrogen is indicated in a good crop of ruta-bagas by very long necks, and by unsoundness, and bad keeping qualities of the roots.

Upon the better classes of soils the potash is not likely to be required. The entire mixture should be sown at the time of drilling the ruta-bagas. When it is determined to use barnyard manure, which, to help the ruta-bagas at all must be well decomposed, and even then is likely to be less effective for the ruta-bagas than for mangel-wurzels, no other manure than 300 pounds per acre of superphosphate will be required in addition to it.

For some countries much to the north of Norfolk no doubt much heavier dressings for the ruta-bagas may be applied with good economy.

When ruta-bagas have been checked in growth and mildewed, but not injured past recovery by summer drought, the application, even rather late in the season, of 100 pounds per acre of nitrate of soda, if shortly followed by rain, will frequently much more than pay for its cost.

Experiments on mangel-wurzels, carried out by the University College of North Wales, Bangor, "bore out the importance of a phosphatic manure for this crop, and in this case superphosphate had a decided advantage over basic slag. Potash manure practically gave no results. Nitrate of soda did not increase the crop to any extent, but where artificial manures alone were used a large crop was got when nitrate of soda had been applied in addition to the other manures."

Experiments on grasses and pasture lands (pp. 35, 37, 46, 57, 59–63, 72, 73).—The results of experiments under the direction of the Norfolk Chamber of Agriculture, during a number of years, with fertilizers on recently seeded meadows and permanent grass lands are summarized. From the former the conclusion is drawn that—

When hay is to be sowed and the mixture composing it contains a good deal of rye grass, it may be found economical to top-dress the seeds in early spring with 100 to 150 pounds of nitrate of soda, or when the clover plant is a good one and it is desirable in particular to encourage it, a dressing of 100 pounds of muriate of potash will frequently have the effect.

Winter dressing of recently seeded grass with barnyard manure is not supported by the results of these experiments. The following fertilizer mixture is recommended for permanent grass: 100 pounds of nitrate of soda, 200 pounds of superphosphate, and 100 pounds of muriate of potash.

The following is a general summary of three years' experiments on pasture land, made under the directions of the University College of North Wales, Bangor:

(1) Phosphatic manures containing phosphoric acid in an easily assimilable condition are the most valuable artificial manures for improving pasture land of the description experimented upon. Such manures encourage a fine bottom growth of grass and clover herbage, and hence are specially valuable in improving pasture land.

(2) Nitrate of soda largely increases the total bulk of hay produced in the first year after application, but this result is not so apparent in the second year. This manure tends to encourage the grasses and to bring the herbage earlier to maturity, and has a deleterious effect on the crop that follows the one to which it is directly applied.

(3) Potash manure has not generally given good results.

(4) Bone meal, for at least two years after its application, has not given good results. Dissolved bones are much more efficacious.

(5) Superphosphate and basic slag are much more economical sources of phosphoric acid as a manure for pasture land than either bone meal or dissolved bones, and while both these manures give good results on the whole, the economic advantages are largely in favor of basic slag of the best quality.

(6) The good results of superphosphate and basic slag are quite as marked in the second and third as in the first year after application.

(7) A dressing of lime on poor pasture land, even in the second season after its application has had almost no effect in improving the quality or bulk of the herbage.

(8) While different manures give different results when applied to pasture, judi-

cious manuring will improve and alter the composition of the herbage of a pasture, although a seed mixture is not sown with the manures.

Two experiments on permanent meadow grass were made at Rostherne (Knutsford) under the auspices of the Royal Manchester, Liverpool, and North Lancashire Agricultural Society. The results of these experiments, as well as of similar ones made in 1892, are summarized on p. 712.

Experiments under the same auspices, with mixtures of grass seeds and the cropping of the same, lead to the conclusion "that for laying down land for permanent pasture it is necessary to avoid grazing it in the first year after the seeds are sown."

Experiments, under the direction of the Agricultural Research Association for the northeastern counties of Scotland, with grass mixtures and on methods of cultivation of clover, are also briefly reported.

Effects of potash on chalk soils (pp. 36, 37, 47).—Of two plats of chalk soil which had been planted to turnips, one was manured with 300 pounds of nitrate of soda, 300 pounds of superphosphate, and 200 pounds of muriate of potash per acre, and the other with 300 pounds of nitrate of soda and 300 pounds of superphosphate, but no potash. The yield of barley from the first plat was 54 bushels of grain; from the other 9 bushels. Clover was sown in the barley on both plats with no additional manure. The plat receiving potash yielded 6¼ tons of mixed hay, part clover; that receiving no potash yielded 175 pounds of rye grass, the clover having failed.

These results are all the more remarkable from the fact that chemical analysis showed the soil of the plats to contain potash in the first foot of surface soil equal to 3 tons of muriate of potash per acre.

The unexhausted residue of manures (pp. 38, 39).—This is an account of experiments carried out under the auspices of the Norfolk Chamber of Agriculture to ascertain the effect of different manures applied to mangel-wurzels in 1886 upon the yield of subsequent crops of barley, grass, and wheat. The results show that the subsequent effect of the barnyard manure was comparatively insignificant.

Experiments with salt on barley (pp. 39, 40).—The effect of dressings of common salt on barley has been tested a number of times by the Norfolk Chamber of Agriculture, but generally with contradictory results. When, however, special precautions were taken to insure uniformity of other conditions, the yield of barley was increased by the salt. In a majority of cases salt appeared to have a very decided tendency to cause the barley to lodge rather than to stiffen the straw as it is commonly supposed to do.

Potato experiments (pp. 64, 65).—This is an account of inconclusive experiments with barnyard manure and commercial fertilizers carried out under the auspices of the Essex Agricultural Society.

Cabbage experiments (pp. 66, 67).—A brief report on experiments under the direction of the Essex Agricultural Society. The results of

these experiments as well as of others of the same kind carried out in 1892 are summarized on p. 716.

Turnip experiments (pp. 67–72).—The results of experiments under the direction of the Highland and Agricultural Society of Scotland on over fifty farms in different parts of Scotland during 1890 and 1891 are thus summarized from the complete report in the transactions of that society:

(1) Steamed bone flour, superphosphate, and very finely ground Thomas slag, when applied in quantities of equal money value per acre, may be of nearly equal efficiency as turnip manures. On light soil the advantage lies with steamed bone flour; on heavy soils the other two are more advantageous. During wet seasons steamed bone flour and Thomas slag are at their best; during dry seasons superphosphate is the best of all. A mixture of these makes a very good phosphatic manure.

(2) In most cases the addition of nitrate of soda to such a mixture has produced a profitable increase in the crop.

(3) The amount of nitrate of soda which may be profitably added to such a mixture is not much more than 50 pounds of nitrate to 350 pounds of phosphates.

(4) When a manure consisting of 350 pounds of phosphates and 50 pounds of nitrate of soda per acre was applied, at a cost of about 15*s.* [$3.60] it increased the turnip crop as much as about 18 loads of barnyard manure.

(5) When, in addition to this mixture, 18 loads of barnyard manure were applied, it produced an increase of less than 4 tons of roots per acre.

(6) It may therefore be inferred that a turnip manure of double strength, consisting of 700 pounds of phosphates and 100 pounds of nitrate of soda will produce a larger crop of turnips at a cost of 30*s.* [$7.20] per acre than can be produced by heavy dunging at four times the cost.

(7) Nitrate of soda is employed most profitably on heavy land, and the slight benefit derived from its application to light land, especially during wet seasons, shows that it is not a suitable form of nitrogeneous manure for that class of land.

(8) The increased crop obtained on very light land by the use of steamed bone flour, and the very slight increase due to the application of nitrate of soda in such circumstances point to the conclusion that the nitrogenous matter of the steamed bone flour is more suitable than nitrate of soda for that class of land, and that a still better result would be obtained by applying very finely ground bone meal which contains about thrice as much nitrogen.

(9) The manures employed in this experiment contained no potash, but former experiments, and also the results of another experiment last year, have conclusively proved that, where no dung is applied, the addition of potash materially benefits the turnip crop, and it is, therefore, evident that for a full crop of turnips some potash manure should be added to the above mixture.

(10) Barnyard manure may with advantage be applied to strong land in autumn. The advantage will be especially great in dry winters, or in the event of a drought in spring.

Effect of slag on oats, after turnips (pp. 75, 76).—This is an account of experiments under the supervision of the Agricultural Research Association for the Northeastern Counties of Scotland. "Forty plats which were treated with various phosphates in 1888, and bore a crop of turnips in that year, and also in 1889 and 1890, were this year seeded to oats, in order to ascertain the relative effect on the oat crop, after turnips." The results show "that the oat crop was heaviest on the plats to which

slag had been given to the previous turnip crop, and also that the superphosphate stood lowest," and lead to the recommendation of the fertilizer mixture for turnips preceding oats in which steamed bone meal is largely substituted by ground coprolite and slag, thus materially reducing the cost.—W. H. B.

Field experiments with fertilizers in Great Britain in 1892 (*Report of Board of Agriculture on Grants for Agricultural Education for 1892–'93, pp. 43–119*).—These experiments were carried out under the same auspices and in many cases are continuations of those described in the previous abstract.

Experiments on grasses and pasture lands (pp. 43, 44, 54–71, 96–98).—The plans and results of experiments made by the Bath and West of England Society with a view to ascertain "what artificial manures can be used with advantage in improving the herbage of old pastures" are briefly reported. The manures used were bone meal, dissolved bones, and lime.

At some stations no appreciable difference between the plats has as yet been observed. But on the whole there is sufficient evidence to prove that the basic slag has so far been most successful, producing an herbage which stock have taken to very kindly and grazed much closer than the other plats. The lime plat stands next in favor, but whether this and the two bone plats will improve their position with time remains to be shown.

Experiments carried out under direction of the University College of North Wales, Bangor, at three different stations in that locality, and extending over periods of from two to three years, are reported in detail.

(1) In trials during three years of various phosphatic manures alone or combined with nitrate of soda or kainit or both, and of barnyard manure on poor, stiff, sour clay soil, with hard, retentive subsoil, the results were as follows:

Phosphatic manures containing phosphoric acid in a condition easily assimilable are the most valuable manures for improving such pasture land. These manures encourage a fine bottom growth of grass and clover herbage.

Superphosphate and basic slag are the most economical phosphatic manures for this land; and, while both these manures give good results, on the whole the economic advantages are largely in favor of basic slag of the best quality. This, however, can not be said of the basic slag of inferior quality. The results show that superphosphate and basic slag are practically exhausted in the third year after their application, but, although the weight of the herbage is not increased after that time, the quality is very much improved, as well as the pasture for grazing purposes.

Bone meal and dissolved bones are more permanent in their effects than superphosphate or basic slag, but they act much more slowly, especially the bone meal. The herbage is now very much improved for grazing purposes where these manures have been applied.

Nitrate of soda largely increases the total bulk of hay produced; it encourages the strong-growing grasses and brings the herbage earlier to maturity. The results show that this manure is valuable for producing heavy crops of hay, but that it is not suited for pasture land, as it destroys the fine bottom herbage by encouraging the coarse, strong-growing grasses and by discouraging clovers and allied plants.

Kainit, as a potash manure, has given slightly increased results, but the value of the increased produce is less than the value of the kainit applied.

Lime applied to this exhausted land, even in the third season after application, has had almost no effect in improving the quality or bulk of the herbage.

In many cases the manures have encouraged the better hay and pasture plants, and have discouraged the weeds, but even on the plats that show most improvement weeds are not exterminated, especially the yellow rattle, which has proved to be troublesome; probably, however, if the field had been kept under pasture instead of being mown the weeds would have been further reduced.

(2) The results of experiments on almost the same plan as the above, conducted in South Wales on soil deficient in lime, are thus summarized:

Basic slag has given the best result, probably because it supplies lime to the land, and also because the kind of soil indicated is that on which the best results have been got by slag. It should be specially noted that where slag was used in conjunction with lime the good results of slag were not nearly so apparent. This may be due to the fact that the lime had neutralized the organic acids which otherwise would have acted on the slag. Basic slag has been more effectual in improving this land for grazing purposes than any of the other manures applied. The results show that 400 pounds of basic slag applied per acre in 1890, at a cost of 8*s.* 6*d.* [$2.04], have, during the three years, given an increase of over 2 tons of hay, and that increase was greater in the third year after its application than in the first or second. It is evident, therefore, that at the end of three years this manure has not been exhausted on this land.

Superphosphate, another phosphatic manure, has given very poor results. This indicates that an acid manure like superphosphate is not suitable for pasture land which is poor in lime, and which, because of excess of organic matter, is probably in an acid condition.

Lime has given a much better result in this experiment than in other similar experiments conducted in North Wales. This is explained by the fact that there is an excess of organic matter in this soil for the lime to act on, and further, that because of the deficiency of lime in this soil, a supply of lime is wanted to act directly as a plant food. Apparently, however, the small amount of lime added in a dressing of 400 pounds of slag to the acre has supplied a sufficient amount of lime for purposes of plant food. The results indicate that basic slag will improve this land much more effectually than lime, and at a less cost.

The results with bone meal indicate that this manure acts very slowly in improving this land.

(3) In a two years' test of the comparative value of different phosphatic manures for grass on clay soil and subsoil, the following results were obtained:

In the second season after the application of the manures the plats which were dressed with phosphates only yielded a better crop than the plats which received nitrate and kainit in addition.

When the crops of both seasons are taken into consideration, the addition of nitrate and kainit gave no considerable increase in the yield, and there was, therefore, little or no return for their application.

Slag gave much heavier crops than superphosphate for the same outlay.

Bone flour, even in the second season, compared very unfavorably with the other phosphatic dressings, notwithstanding its much greater cost.

An application of 400 pounds of slag alone, at a cost of only about 9*s.* ($2.16), produced crops weighing 13 tons 698 pounds from land which, when unmanured, yielded about 8 tons 540 pounds.

The herbage of the plats which received phosphates only looked better and contained more white clover than that of the plats which received nitrate and kainit in addition.

In addition to these experiments with fertilizers, the college institute in 1891 made tests of the adaptability of various grasses and forage plants and trials of various mixtures of grasses and clovers.

The results of experiments during 1891 and 1892 with barnyard manure, lime, and various commercial manures on permanent grass at Tatton Park, Cheshire, are briefly summarized. The results in the two seasons are somewhat conflicting, owing to the unfavorable weather in 1892. The best results were obtained on plats receiving (1) basic slag, kainit, and nitrate of soda; (2) superphosphate and dried blood; (3) superphosphate, kainit, and nitrate of soda; and (4) superphosphate and nitrate of soda. "In spite of what was undoubtedly an unfavorable hay season, an increased bulk was obtained by the best manures at a price which left a wide margin of profit on the extra outlay, while the herbage has been greatly improved."

Experiments with salt on barley and wheat (pp. 44–46, 51, 52).—The results of experiments, by the Bath and West of England Society, on the effect of adding salt to nitrate of soda in a manure for wheat, show that while the increase in yield was not very marked, improvement in quality was very decided on plats receiving salt. Experiments by the Norfolk Chamber of Agriculture in this line, at three places in that locality, gave inconclusive results in both 1891 and 1892.

Experiments on barley and wheat (pp. 47–50, 52, 93, 95).—These include tests of varieties of wheat and barley and fertilizer experiments on barley after mangel-wurzels by the Norfolk Chamber of Agriculture, and tests of varieties of wheat and experiments with fertilizers on barley under the supervision of representatives of the Essex Agricultural Society. In the first case the results indicate that—

Barley does not require any special addition of mineral manures, those applied to the other crops in the ordinary course of the rotation being sufficient for it. On the other hand, it is largely benefited by the direct application of nitrate of soda or some form of soluable nitrogen.

The addition of 300 pounds of salt to the 150 pounds of nitrate of soda did not improve the crop, and the barley on the plat to which it was applied did not stand so well as that receiving nitrate alone.

In every case where more than 100 pounds of either nitrate of soda or sulphate of ammonia was applied the crop went down more or less, and on the plats receiving 200 pounds of nitrate, or the equivalent 150 pounds of sulphate of ammonia, the barley was badly laid, nor did these larger dressings produce any considerable increase in the crop.

This shows the liability of soluble nitrogen to cause crops to go down, especially on strong land.

The plats receiving nitrogen gave in every case more straw than either the nothing plats or those receiving minerals alone.

In the second case the soil was calcareous and the fertilizers used were superphosphate, sulphate of potash, and nitrate of soda, singly or combined.

Phosphatic manures and potash appear on the whole to have been useless, except, perhaps, in one case, but there are many inconsistencies in the results that are—as is unfortunately so often the case in field experiments—no doubt due to the irreg-

ularities in the natural yield of the plats themselves, apart from manuring. The best yield was that obtained in the plat manured with nitrate alone, which gave 12 bushels more than the higher of the unmanured plats at an outlay of only 10*d.* ($0.20) per bushel.

Rotation experiments (pp. 50, 71–74).—The rotation followed under the supervision of the Norfolk Chamber of Agriculture was mangel-wurzels planted in 1890 and manured with a mixture of salt (200 pounds) and nitrate of soda (100 pounds), alone or combined with 10 or 20 loads of manure per acre, followed successively by barley and clover. The manure applied to the mangel-wurzels in 1890 produced a distinct though small effect in 1892.

In experiments commenced near Newtown, Wales, in 1892, under the direction of the University College of North Wales, Bangor, the proposed rotation was roots, barley, clover, and wheat. In this the first year ruta-bagas were grown and manured with slag and barnyard manure, alone and combined with superphosphate or nitrate of soda or both, with superphosphate alone, and with a mixture of dissolved bone and nitrate of soda. From the first year's results it may "be safely stated that a moderate dressing of farmyard manure, supplemented by phosphates and nitrate of soda, is the most generally desirable method of manuring the ruta-baga crop, but that a mixture of phosphates and nitrate is capable of producing a good crop without the aid of any barnyard manure."

Experiments with phosphatic manures on ruta-bagas (p. 53).—Experiments under the auspices of the Norfolk Chamber of Agriculture are thus summarized:

The experiments to determine the value of different forms of phosphatic manures when applied to ruta-bagas were, with a slight alteration, last year repeated for the fourth time, and the results confirmed those of former years to a great extent.

Taking the results all around, superphosphate has come out just about equal to bone compound and dissolved bones, and taking into consideration that phosphates can be bought cheaper per unit as superphosphates than in any of the bone preparations, the conclusion must be again arrived at here that superphosphate is the most profitable form in which phosphatic manure can be applied to ruta-bagas. The phosphate it contains is both cheap and soluble, and bone phosphates do not seem to have any advantage over it.

Basic slag seems to have given a better account of itself last year than before. On one of the plats at Whitlingham it gave a ton more ruta-bagas than anything else; but on one of the plats at Flordon it gave no increase at all over the nothing plats.

On the peaty land at Elmham it gave results quite as good as any of the other manures; but much stress can not be laid on this as there was so little difference between the plats there.

Experiments on turnips (pp. 75, 84, 99–113).—A full report is given of experiments at four different stations carried out under the supervision of the Durham College of Science. They were "arranged principally to test the relative values of the chief varieties of phosphatic manures."

Five hundred pounds of bone meal were taken as the basis of the calculations, and the same weight of phosphoric acid (or its computed equivalent of phosphate of

lime) was applied in the case of the other manures, except where a manure contained soluble phosphate, and then 2 pounds of such phosphate were considered equivalent to 3 pounds of insoluble phosphate. When a phosphatic manure contained either no nitrogen or less than the bone meal, the necessary quantity was added in the form of blood meal, a substance which contains nitrogen in much the same form as bones. * * *

The general conclusions that may be drawn from these experiments may be summarized:

(1) Thomas basic slag is the cheapest pure phosphatic manure.

(2) A mixture of slag and superphosphate is a more efficacious dressing than either of these substances used separately.

(3) Part of a turnip manure should consist of soluble phosphate.

(4) Kainit as a rule may be profitably added at the rate of 200 pounds per acre to a turnip manure.

(5) A purely phosphatic manure is quite unable to grow a full crop of turnips, a certain amount of nitrogen being absolutely necessary.

(6) Superphosphates alone added to dung is not directly profitable when used in large doses.

(7) Nitrogen used in the quantities of the experiment [about 50 pounds of nitrate of soda and 500 pounds of bone meal] is not a profitable addition to 16 loads of farmyard manure.

(8) So far as the turnip crop is concerned, artificial manures are more profitable than dung.

(9) Small doses of artificial manures are always more directly profitable than large doses.

Similar experiments made by representatives of the Highland and Agricultural Society had the following objects:

(1) To compare the effect of bone meal, superphosphate, and Thomas slag as phosphatic manures for the turnip crop, along with a definite amount of nitrate of soda.

(2) To discover what proportion the nitrate of soda should bear to the phosphate.

(3) To compare the effect of nitrate of soda with that of an equivalent amount of sulphate of ammonia; and

(4) To test the relative merits of nitrate of soda and of sulphate of ammonia as a soluble nitrogenous manure for the turnip crop, and to discover the most advantageous way of applying them.

There is also a report on observations on the effect of thinning on yield and composition of the crop. Experiments covering especially the first three points extending over four years are summed up as follows:

(1) Bone meal has not been so good a manure as slag and superphosphate, to which an equivalent quantity of nitrate of soda or sulphate of ammonia is added.

(2) For bone meal, and also, though to a less extent, for slag, mild growing weather in autumn is required in order to produce a fair return for the expense of the manures.

(3) A mixture of slag and superphosphate is a good safe phosphatic manure for promoting the growth of turnips, both in the early and later part of the season.

(4) More than 100 pounds of nitrate of soda per acre does not pay.

(5) The result of applying 200 pounds per acre of nitrate of soda is to produce an undue undergrowth of tops, and to render the crop more liable to disease during winter frosts.

(6) Nitrate of soda, though more liable than sulphate of ammonia to be washed down through the soil during a wet summer, when applied to light, thin soils containing little organic matter, is more advantageous than sulphate of ammonia on

such soils during a cold dry summer; and therefore it is expedient to apply to even the lightest soils a certain amount of nitrate of soda in a turnip manure.

(7) Sulphate of ammonia is more active upon heavy than on light land, and exerts its influence chiefly in the latter part of the growing season. * * *

(8) Dunging in the drills is a very expensive method of manuring turnips, and experiments are wanted to see if the plowing in of dung on the turnip-break in the late autumn or early winter would not produce a safer and better crop.

The results of a single year's investigation of the fourth topic given above indicate that—

Nitrate of soda has a trifling advantage over the sulphate of ammonia as regards the weight of roots produced per acre, but the difference is not worth considering. On some soils the one was better and on others the other. A much more important thing than the actual weight of bulbs in this case is the fact recorded by many of the experimenters that the section manured with sulphate of ammonia produced a sounder turnip than that manured with nitrate of soda. This is an important confirmation of the results obtained at the society's experimental station at Pumpherston.

As regards the method of applying these two manures, it is shown that in a somewhat dry and certainly cold and backward season it is better to apply them at the time of putting in the seed. Nearly as good results have been got by applying them in two halves—the one half with the seed and the other at a later period. It is probable that if the second half had been applied a little earlier, the result would have been better.

Experiments on potatoes (pp. 84–86, 91–93).—These include experiments made under the direction of the Durham College of Science and the Essex Agricultural Society. In the first case it appears that nitrogenous manures alone produced only a small increase of crop; superphosphate alone did considerably better than the nitrogen alone; the kainit did much better than either the nitrogen or phosphate; nitrogen and phosphate and nitrogen and potash each produced better results than either separately; but superphosphate was not able to add anything to the yield produced by kainit alone.

The farmyard manure alone has produced a larger yield than any of the artificial dressings, though the percentage of small tubers is higher than in some of the other cases. Although a mixed artificial dressing added to farmyard manure has only been instrumental in increasing the gross yield by 1,350 pounds, as compared with farmyard manure alone, it has been able to increase the good potatoes by nearly 2,200 pounds. It will thus be found, with potatoes selling at a fair price, to have been a profitable addition to the dung.

A perusal of the results in the second case shows that—

While 7 tons of dung raised the unaided produce of the soil by 3¼ tons per acre, the doubling of this dressing to 14 tons of dung only produced 1½ tons more, and that the addition of artificials, when the larger quantity of dung was used, did not further remuneratively increase the crop. On the lightly dunged plats the best results were obtained, with one exception, by the use of 400 pounds of superphosphate and 200 pounds of nitrate, which gave 1 ton 350 pounds more than dung alone. On the lightly dunged plats the application of potash, where added to superphosphate or nitrate, appeared to have a negative value. Added to guano and nitrate, it appeared to result in a gain of 1,400 pounds; while added to superphosphate and sulphate of ammonia it seemed to give an increase of 2¾ tons.

On the heavily dunged plats potash [14 tons] produced no increase with superphosphate and nitrate, but again gave a small gain (800 pounds) with guano and nitrate, and a large gain, nearly 2½ tons, with superphosphate and sulphate of ammonia.

Experiments on cabbages (pp. 89–91).—These experiments were made under the auspices of the Essex Agricultural Society and "appear to indicate that a very large increase in cabbages is obtainable by the use of artificial manures, either with or without dung, at a very reasonable cost. Salt, which elsewhere has given remarkably good results with cabbages, does no good to this crop on this land, nor does potash. A dressing of 400 pounds of superphosphate and 400 pounds of nitrate of soda, the latter being applied in several successive doses, when used without dung, raised the produce by 11½ tons of cabbages per acre at a cost of only 4*s.* 9*d.* [$1.14] per ton of cabbages. Used with dung it raised the produce by 7¾ tons beyond the yield of the dung only, at a cost of 6*s.* 5*d.* [$1.54] per ton."

Observations on oats following cabbages which had been heavily fertilized with manure combined with guano and various fertilizer chemicals indicated "that large crops of cabbages can be economically grown by the fairly lavish use of artificial manures in addition to dung, without lowering the fertility of the land."—W. H. B.

The culture of barley for malting purposes; a report of ten years' experimental work, C. SONNE (*Tidsskr. Landökon., 12 (1893), pp. 513–619*).—The work reported was conducted by a committee of the Royal Danish Agricultural Society, under the direction of the author. The object sought was to study carefully and in a scientific manner the conditions for producing barley of the best malting quality, and the influence of the conditions at harvesting time, of the seed barley, the time and method of sowing, quantity of seed, etc., on the yield and the quality of the barley from the brewer's standpoint. The work was done on several large farms, under the immediate supervision of the author, and also on a large number of small farms, which were supplied with seed from the committee.

The influence of the harvesting conditions on the quality of the barley.—This question was studied for five years on a large number of farms. It was soon found that the conditions prevailing at harvesting time exerted a considerable influence on the mealiness of the barley, the degree of mealiness increasing regularly with the maturity of the crop when harvested. Barley may turn hard while still on the stubble or when left in the field after cutting, through continued rains. The average results of all the trials made in regard to the influence of the time of harvesting are given in the following table:

Influence of time of harvesting on mealiness and weight of barley.

Time of harvesting.	Mealiness.	Weight per 1,000 grains.	Weight per bushel.
	Degree.	*Grams.*	*Pounds.*
Green-ripe stage	26.36	43.469	44.0
Yellow-ripe stage	25.68	45.380	45.0
Dry-ripe stage	32.92	45.568	44.9

The degree of mealiness was ascertained by examining the section of 100 grains of each sample. In all 298,000 grains of 1,490 different samples were examined in these experiments, representing about three hundred days' work for one man.

Fully matured harvested barley will lose more in quality by being exposed to rains when ready to be stacked than may be gained under the most favorable conditions through the action of moisture. The experience concerning the proper conditions of harvesting is summed up as follows: "Barley which is harvested when fully ripe must be protected from rain between cutting and stacking. This is the more important the more rainy the period directly preceding the cutting.

"If the barley can not be stacked directly after the cutting, the best quality of the barley will be secured by cutting at an earlier stage, near the 'yellow-ripe period.'"

The influence of the seed used.—From 5 to 16 farms were used in the investigation each year from 1883 to 1892, the number of varieties tested during each year ranging from 2 to 24. The grain raised was in all cases carefully examined for weight, shape, color, quality, mealiness, etc., and the nitrogen content determined. The soil was found to be of primary importance to the quality of the crop. It was also found that an increasing nitrogen content in the barley as a general rule coincided with a corresponding decrease in the qualities which determine its commercial and general value for malting.

Producers of barley for malting purposes must consequently expect to meet greater difficulty in producing crops of good quality, according as the land produces richer and more nitrogenous crops.

Time of sowing.—It was found that the largest crops were obtained when the sowing was done during the first week after the ground could be worked. The quality of the crop decreased regularly for all varieties with the later time of sowing, so that the earliest sowing produced barley of the best quality, with the second date of sowing (about eight days later) following closely. The content of nitrogen in the barley increased with later sowings, which was then accompanied by a decline in the malting quality. "The aim of the producer of barley for malting purposes must be to produce a crop poor in nitrogen."

Sowing in drills or broadcast.—Three varieties were sowed by both methods on 14 experimental forms during 1890–'92. In both cases the following quantities of seed were used per acre: 127.4, 141.4, 182.1, 222.5, and 262.9 pounds. The following summary of 420 single trials shows the average result as to both the quantity and the quality of the crop:

Yield and quality of barley sowed in drills and broadcast.

	Yield of barley.			Quality.				
	Grain per acre.	Straw per acre.	Total.	Weight of 1,000 grains.	Shape.	Color.	Quality.	Total score.
	Pounds.	*Pounds.*	*Pounds.*	*Grams.*				
Sowed in drills	2,387	3,176	5,563	42.359	4.09	3.72	3.74	11.55
Sowed broadcast	2,392	3,228	5,620	42.318	4.11	3.76	3.78	11.65

"While the average results of the 420 drilled plats and the corresponding plats sowed broadcast are practically the same, the drill sowing showed a noticeable increase compared with the broadcast sowing in case of the more heavily yielding Prentice barley, and this is especially true with the quantity of seed generally applied in practice, viz, nearly 3 bushels (141.4 pounds) per acre. In case of the two other varieties (Lerchenborg and Hallett barley), which yielded less heavily, the broadcast sowing gave on an average the largest yields, the difference being not very pronounced, however. It seems that the relation between drill and broadcast sowing will be changed in favor of the former as the productive capacity of the soil increases. Where a small amount of seed is preferred, in case of highly productive soils, drilling is to be recommended."

The influence of the quantity of seed used.—From 40.5 pounds to 218.5 pounds of seed per acre were applied. Both the weight of 1,000 kernels and the quality of the barley decreased slightly but regularly with increasing quantities of seed barley. Considering all experiments (33 series), a quantity of 3.8 bushels (182 pounds) per acre gave the best results. "While land yielding crops of 17 to 18 times the seed sown and over yielded the largest crops when about 2.3 bushels were sown, both in case of drilling and broadcast sowing, it has proved most profitable to use larger quantities, up to 3.8 bushels per acre, with a decreasing productive capacity of the land."

Distribution of seed barley.—From 1885 on, 2,274 fifty-five-pound bags, or 125,070 pounds in all, of seed barley were distributed to 1,473 farmers. It was found on investigation that the varieties furnished by the committee to 531 farmers were used continually for seed barley by two thirds of them, and also that the yield obtained was increased on an average 1.61 times the quantity sown above that obtained from barley previously sown by the same farmers. The 531 farmers had sown in all 11,016 acres of land with barley furnished by the committee.

The last part of the report is taken up with a discussion of the statistics of barley production and exportation from Denmark and the prospects for the future.—F. W. W.

The culture of Lathyrus sylvestris, A. BOSWINCKEL (*Deut. landw. Presse, 20 (1893), No. 97, p. 1007*).—In the spring of 1891, in Rhenish Prussia, the author set out 5 hectares with flat pea plants. A dry, clay soil was used. The land was thoroughly prepared, but not manured, and the plants, after pruning the roots, were dropped in furrows at distances of 32 cm., and then so plowed in with a single plow as to cover the plants 3 to 4 cm. deep. One hundred thousand plants were thus set out on April 10 and 11, and an equal number on May 8 and 9. The earlier plantation was cultivated with the hoe on and after May 23. The growth of weeds was more rapid than that of *Lathyrus sylvestris*, and cultivation was rendered slow and difficult. When winter came on the plants had made but slight growth.

When set, a part of the plants had very slender dark-brown roots, while the others had strong white roots. Of the former lot of plants only one sixth had made any growth by winter.

In April, 1892, on one half hectare, with a clay soil fertilized in the previous autumn with Thomas slag and kainit, 30,000 plants with strong roots were set out with a plow. Almost all of these grew finely; some bloomed when 75 cm. long, and a few of the roots attained the size of the thumb. On account of the dry season the weeds were easily kept down by cultivation.

Of the plants set out in 1891 only a small part bloomed in 1892, and this field could not be mowed. The plants which had failed to grow in 1891 now made their appearance.

In the spring of 1893, with a sharp, heavy harrow, the author harrowed a part of the fields set in 1891 and 1892. On the earlier plantation the line of demarcation between the harrowed and unharrowed portions was plainly visible by the larger growth on the harrowed portion. On the portion not harrowed the plants were scarcely large enough to be mowed.

The growth on the field set in 1892 was excellent, but here too the harrowed portion was better than the other. The stand was thick and the plants about 1.5 meters high.

Cattle and sheep relished the fodder greatly. The author considers this a very valuable forage plant, especially for dry seasons. Strongly rooted plants, thoroughly prepared soil free from weeds, and the use of mineral fertilizers are, in the author's opinion, requisite to success in growing *Lathyrus sylvestris*.—J. F. D.

Concerning Lathyrus sylvestris, HAUTER (*Deut. landw. Presse, 20* (*1893*), *No. 87, p. 905*).—Near Radolfzell, in the southern part of Germany, is a field of *Lathyrus sylvestris* a part of which was planted five years ago and a part in succeeding years, including 1893. The soil of the field is permeable, with rocks and pebbles cropping out through a calcareous loam. In places there is sand on which sainfoin flourishes; the better portions of the field are capable of supporting a good growth of alfalfa and red clover. Small grains, hops, root crops, and fruits flourish in the neighborhood.

Only the growth of the current year, kept free from weeds, presented a good appearance; former plantings were smothered with weeds and native grasses.

In another locality, near the above, the appearance of a field of *Lathyrus sylvestris* was better, plants several years' old growing to a length of one meter. From the appearance of the field the author estimated the crop of forage on the best spots as about equal to a small crop of vetch. He states that on October 4 all the parts of the plant then green were suffering from the attack of a fungus.

Between Radolfzell and Meggingen a culture plat of *Lathyrus odoratus* was noted, and this also presented a poor appearance.—J. F. D.

An investigation on the nature and repression of equisetums, Petersen and Hessenland (*Milch Ztg., 22 (1893), No. 39, pp. 641, 642; No. 40, pp. 658, 659; No. 41, pp. 671, 672*).—The authors give detailed descriptions, distribution, and all the more important facts relating to the life history of three of the more important species of horsetail rushes, as follows: *Equisetum limosum*, *E. palustre*, and *E. arvense*, all of which are abundant and more or less troublesome in parts of Europe. The last two are reputed as dangerous to young cattle, and as *E. arvense* grows in almost any soil, it may become a source of considerable loss through the death of calves or even older cattle. The plants spread by means of spores, rootstocks, and rooting of the broken and scattered joints, and of necessity will soon become abundant when once established. Chemical analyses are given of the fruiting stems, sterile stems, air-dry contents, and ash constituents. The dry matter of equisetum is compared with that of four kinds of hay, which it greatly exceeds in ash, potassium, lime, phosphoric acid, and silicic acid. The animals suffering from the effect of these plants become weak in their hinder parts, lack nourishment, are severely purged, the blood becomes thin, and their teeth fall out. Milch cows eating this plant will lose 50 per cent in their yield within twenty-four hours, and the milk will be poor in quality.

Investigations have been conducted to ascertain some means for the repression of this weed. It has been found that it will soon yield to clean cultivation and the use of salt or kainit as a fertilizer.—W. H. E.

Examination of wheat bran and rye bran, V. Stein (*Tidsskr. Landökon., 12 (1893), pp. 665–682*).—One hundred and twenty-three samples of wheat bran and 4 samples of rye bran were taken by county agricultural societies in different parts of Denmark and sent to the Royal Danish Agricultural Society for examination. Unfortunately only a mechanical and microscopic and no chemical examination of the samples was made.

The samples of wheat bran were separated into five groups: (1) Pure brans; (2) brans not quite pure, but impurities not sufficient in quantity or quality to condemn the goods; (3) impure brans—wheat sweepings, chaff, weed seeds, etc., purposely mixed in; (4) highly impure, from the same sources; and (5) brans containing admixtures of rye bran. Forty samples came in the first group, 34 in the second, 35 in the third, 8 in the fourth, and 5 in the fifth, or 33, 28, 29, 6, and 4 per cent, respectively. One sample was thrown out, having been accidentally adulterated. Thirty-five per cent of the samples were consequently found to be adulterated with larger or smaller quantities of worthless refuse material. Sixty-seven out of 100 samples were imported; the 5 samples in group 5 were all Danish.

All the 4 samples of rye bran (all Danish) were pure.—F. W. W.

A new cause for bitter milk, Vandenhoydonck (*Schweiz. Arch., 35; abs. in Molk. Ztg., 7 (1893), No. 51, p. 693*).—The author reports a

case coming under his notice in which all the cows in a little village suddenly commenced to give bitter milk. The milk frothed badly during creaming, appeared to be in vigorous fermentation, and was very bitter. After this had gone on for some months and local skill had proved of no avail veterinary aid was sought. The cows were found on examination to be perfectly healthy. The source of the trouble was finally discovered in the excessive feeding of Swedish turnips which had been washed in foul ditch water. Soon after the feeding of these was discontinued the milk became normal.—E. W. A.

An investigation of Danish creamery and dairy butter, 1889–'92, F. Friis (*Samlet beretning om de sammenhaengen-de raekker af smör udstillinger, 1889-'92, Kgl. Vet. og. Landbohöisk. Lab for landök. Forsög, 28th Report, Copenhagen, 1893, pp. 217*).—In 1889 the late Docent N. J. Fjord planned and inaugurated a series of exhibitions of Danish dairy and creamery butter at the Royal Experiment Station at Copenhagen, and these exhibitions have been continued ever since. At present the Danish Government makes a special appropriation of 24,000 kroner (about $6,480) annually.

The primary object of the butter exhibitions is to furnish the creameries and dairies exhibiting their butter with reliable information as to its quality and, in case of its being inferior, its particular shortcomings. To this end the butter is scored twice independently by three juries of four members each, three of which are butter dealers and one a state dairy counsellor. The first scoring takes place two days after the receipt of the butter at the station, and in order to test its keeping quality the second scoring is made fourteen days after the first scoring. The scoring is done on a scale of 15 points and the butter divided into 8 classes, the first class including all brands scoring three points or more above the average of all samples in the same exhibition, and the eighth class (poorest) including all scoring three or more points below this average.

The participating creameries and dairies are required to send about 100 pounds of their regular make immediately on the receipt of a telegram from the station. For this butter the station pays the average price received by the factory during the week the tub is sent. The butter on exhibition is sampled both times when scored and the water content determined.

In 1889 319 creameries and dairies took part in the exhibition, and the number of exhibitors has increased each year, reaching 550 in 1893. Three exhibitions were held during 1889, 18 during 1890, 9 during 1891, and 31 during 1892. On account of the increased number of factories participating only annual exhibitions will be held in the future. The present report is for the year 1892, during which 423 factories (319 creameries and 104 private dairies) took part in the 31 exhibitions.

Some of the results of the examination of the butter exhibited are briefly stated below:

Comparison of creamery and dairy butter.—In all 471 tubs were received from dairies and 1,391 tubs from creameries. The difference in the average quality of the two kinds of butter was very small, amounting to 0.54 point in favor of the dairy butter. Taking the average for the whole year 62.7 per cent of the dairy butter and 50.9 per cent of the creamery butter fell in the first four classes. Of that received during the summer 51.8 per cent of the dairy butter and 56.2 per cent of the creamery butter fell in the first four classes, and of that received during the winter 50 and 46.7 per cent, respectively. The reason for the superior quality of the dairy butter during winter the author traces to the fact that most of the cows at the large estates are fresh in milk during that time, which is not the case to so large an extent on the farms furnishing milk to creameries. The feed may also have had some influence.

The creamery butter in the first four classes did not keep quite as well as the dairy butter in the same classes, but on an average for all butters examined there was a slight difference in favor of the creamery butter as far as the keeping quality was concerned. The different parts of Denmark furnished on an average equally good butter. No marked difference was found in the quality of butter from large and from small creameries, and altogether the creamery butter examined compared very favorably with that from private dairies.

Brine, shrinkage, and water content of the butter.—Out of 790 tubs of summer butter 109 (14 per cent) lost brine on being kept for fourteen days, while 477 out of 1,072 tubs of winter butter (44 per cent) lost brine. The tubs were placed on stands immediately on their receipt at the station and the brine leaking out was caught in narrow-mouthed flasks and weighed. The average loss of brine during the two weeks in which the butter was kept was 0.05 pound per tub for the summer butter and 0.22 pound for the winter butter. There was no connection between the quality of the butter and the loss of brine. As a rule the loss of brine was not due to a greater water content, as there was no apparent connection between the two.

A moist appearance of a butter is an indication that it will lose brine on standing and not of an excessive water content of the butter. The loss by evaporation was greater in butter losing brine, in proportion to the amount of brine lost. There was only a small difference between summer and winter butter in this respect.

Water content.—This has already been given in the preliminary report issued by the station (E. S. R., vol. IV, p. 690). The average for all butter examined (2,091 samples from 468 different factories) was 14.59 per cent of water. Eighty-five per cent of the factories sent butter containing 13 to 16 per cent of water, and only 5 per cent had butter containing more than 16 per cent of water. The average water content of creamery and of dairy butter for summer and winter was as follows:

Water content of winter and summer butter.

Season.	Creamery.	Dairy.	Average of all.
	Per cent.	*Per cent.*	*Per cent.*
Winter	15.15	14.46	14.97
Summer	14.08	14.19	14.11

The water content of the creamery and dairy butter reported in this bulletin was as follows, arranged for the first and the last four classes:

Water content of good and poor butter.

Class.	Creamery.	Dairy.	Average of all.	Number of samples.		
				Creamery.	Dairy.	Total.
	Per cent.	*Per cent.*	*Per cent.*			
Class I–IV	14.26	14.41	14.37	191	504	695
Class V–VIII	14.48	14.92	14.83	121	472	593
Average for all classes	14.34	14.66	14.58	312	976	1,288

It may be said in general that the more watery the butter was the poorer its quality, and *vice versa.* Butter with a normal water content of 13 to 16 per cent kept best. A too low water content decreased the keeping quality while a too high content was found to be coincident with inferior quality as well as poor keeping quality of the butter.

The shrinkage of the butter by evaporation was shown to be independent of the water content.

Influence of working the butter on its water content.—In case of both summer and winter butter, that worked only once was found to contain nearly one half per cent more water than that worked several times. The longer the interval between salting and last working the less water was found in the butter, amounting in some cases to 1 per cent. Thirty-six per cent of the butter worked once lost brine, against 26 per cent for that worked twice or more. The quantity of brine lost was also larger for butter worked once.

Experiments in working water into butter.—Two series of experiments were made, one in working water into butter after it was ready for market, and another in working it in during the manufacture. Brine was sprinkled over the butter in each case and worked in by rapid revolutions of the worker. The results of the first series showed that a considerable quantity of water might be worked into butter after it was made. Two pounds of water was thus incorporated into 25.4 pounds of butter in one trial, and the average in five trials was 0.78 pound of water to 23.96 pounds of butter. This increased the average water content of the butter which was originally 14.97 per cent to an average of 18.18 per cent. The grade and the keeping quality of the butter was greatly reduced by this procedure, however; and the author states that fraudulent incorporation of water can only be done at the expense of the quality of the butter, which is lowered in propor-

tion to the water incorporated. The results of the trials of incorporating water into butter in its manufacture proved that neither the quality nor the quantity of the butter was changed appreciably in this manner, although there was a tendency in the same direction as in the first series. The adulteration of butter with water would not pay on account of the extra expense for labor and brine.

Influence of food on the quality of the butter.—Although the investigation did not properly include this question, data were obtained as to the cattle foods fed at the dairy farms exhibiting butter and are tabulated in the bulletin. The information given on this point is of necessity not very definite, however. The butter placed in the first four classes came from farms where, as it seemed, a little more of grain feeds and of oil cakes were fed than on farms furnishing the poorer grades of butter. Barley, oats, palm nut meal, sunflower-seed cakes, and cocoa meal seemed to be fed in a little larger quantities on the former farms than on the latter; cotton-seed meal and sugar-beet chips, on the other hand, were fed in a little smaller quantities on farms furnishing the best butter, and ruta-bagas, turnips, and carrots about in similar quantities in either case.—F. W. W.

The "melting test" of butter, E. REICH (*Milch Ztg.*, *22* (*1893*), *No. 48*, *pp. 787–789*).—This test depends upon the difference in the appearance, the apparent color, and the odor of pure butter and of margarin when melted. It is only recommended as a preliminary test and no claim is made that it is invariably conclusive. The observation is made when the sample is melted in preparing it for the determination of volatile fatty acids. Pure fresh butter when melted is said to be perfectly clear or only slightly cloudy, to be usually dark-yellow, and to have the familiar odor of pure butter fat. Pure stale butter may be very cloudy and even opaque when melted, is usually of a dark-yellow color, and has the odor of rancid butter. Melted margarin, on the other hand, is said to be very opaque, of a light-yellow color, and to have a characteristic indescribable odor. The author applied this test to 44 samples in which he subsequently determined the volatile fatty acids. The results as given show that out of the 34 samples indicated as normal butter by the melting test, 28 had the normal content of volatile fatty acids, and 5 could hardly be regarded as suspicious. Out of 9 judged from the melting test to be impure 7 were found impure from the content of volatile fatty acids, and the remaining 2 were regarded suspicious. Thus the indications of the melting test and the content of volatile fatty acids agreed in 70 per cent of the cases.—E. W. A.

Report on special research in cheese-making (*Report on the Distribution of Grants for Agricultural Education in Great Britain, 1891–'92, pp. 77–94*).

Cheddar cheese-making.—A report of trials in cheese-making at a dairy school. One experiment is reported in which the maker was guided

entirely as to the time to stop stirring the curd and the time to grind it by determinations of acidity. The cheese was made September 10, and when sold December 31 "it was considered excellent." This is the only experiment reported, although various observations on cheese-making are reported.

Cheshire cheese-making.—A report of experiments at the Worleston Dairy Institute, made at the instance of the British Board of Agriculture. Cheese was made by the "old" and the "early ripening" processes. "In manufacturing cheese by the 'old' Cheshire process the chief object aimed at is to prevent any undue development of acidity, and with this object in view the whey is removed as completely as possible from the curd, both before vatting and in the press; while in the 'early ripening' process methods are adopted by which the lactic fermentation shall proceed with more or less rapidity."

Some data are tabulated as to the conditions of manufacture, but none as to the losses. "One obvious and practical conclusion to be drawn from the results is that in the 'old' process the temperature of the night's milk should be sufficiently low to prevent any undue development of putrifactive organisms during the time that the milk is standing in the dairy, and that what production of acidity is required should be obtained while the cheese-maker has the curd under his control."

From the results of the "early ripening" process it seems probable that "too rapid development of acid produces a cheese of inferior quality."—E. W. A.

Report on special research into the processes of Cheddar cheese-making (*Report on the Distribution of Grants for Agricultural Education in Great Britain, 1892–'93, pp. 131–146*).—Experiments were carried on in 1892 from April to October on a farm at Axbridge. The milk used, the whey, and the cheese were analyzed. The indications from the results of the year were as follows:

(1) The quality of milk varies on the same farm each year, owing to the season, and on the same fields each month, owing to the food. It varies on two farms during the same year, and on each has a characteristic composition due to the nature of the soil.

(2) The quality of a cheese, assuming that the manufacture was conducted by a skilled maker, depends largely on the quality of the milk from which the cheese was made.

(3) The manufacture of a cheese must vary in accordance with the varying quality of the milk. Not only is this true as regards the quantity of rennet to be used, but it influences the degree of acidity which may with advantage be obtained in the curd before vatting.

(4) On good soils and with rich milk a high acidity in the curd is desirable; but on heavy land yielding a poor milk a low acidity is desirable.

(5) A cheese made with low acidity requires longer to ripen, and probably a higher temperature, than a cheese with high acidity.

(6) In the spring the temperature of the dairy should be maintained artificially at from 64° to 66° F.

(7) In order that the curd may be put away in good time, it is essential to obtain sufficient acid in the whey before drawing it off.

(8) The acidity of the mixed milk, etc., before renneting should, if possible, be 0.21 per cent, and of the whey in the tub before drawing 0.20 per cent, so as to insure in the whey when drawn an acidity of 0.22 per cent.

E. W. A.

The relation between the textile strength and the hygroscopicity of hemp and flax, C. A. LOBRY DE BRUYN (*Chem. Ztg., 17 (1893), No. 78, pp. 1432, 1433, fig. 1*).—The author refers to the investigations of T. Schlösing, jr., who found that the hygroscopicity of textile fibers depended upon the degree of saturation of the surrounding air and the temperature. Schlösing investigated wool, silk, and cotton, to which the author adds hemp and flax. The textile strength seems to increase proportionally with the degree of hygroscopicity. Flax and hemp were found to be much more hygroscopic than cotton, due probably to the different formation of the fibers and the presence of some pectic material wanting in cotton.—W. H. E.

TITLES OF ARTICLES IN RECENT FOREIGN PUBLICATIONS.

CHEMISTRY.

Further contribution to the analysis of fish guano, poudrette, and similar substances (*Weitere Beiträge zur Analyse von Fischguano, Poudrette und dergleichen Substanzen*), M. WEIBULL.—*Chem. Ztg., 18 (1894), No. 3, pp. 31, 32.*

Analysis of seeds and grains (*Die Analyse der Samenarten*), A. VON ASBÓTH.—*Chem. Ztg., 18 (1894), No. 3, pp. 32, 33.*

On casein and the organic phosphorus of casein (*Sur la caséine et le phosphore organiqué de la caséine*), A. BÉCHAMP.—*Compt. Rend., 117 (1893), No. 26, pp. 1085–1088.*

Contribution to the determination of nicotine in tobacco (*Beitrag zur Bestimmung des Nicotingehaltes der Tabake*), G. HEUT.—*Arch. Pharm., 231 (1893), p. 658; abs. in Chem. Ztg., 18 (1894), Repert., p. 5; and in Chem. Centbl., 1894, I, No. 5, p. 307.*

On the constitution of albuminoid matters from plants (*Recherches sur la constitution des matiéres albuminoides extraites de l'organisme végétal*), E. FLEURENT.—*Compt. Rend., 117 (1893), No. 23, pp. 790–795.*

On a mucoid substance occurring in egg albumen (*Ein im Hühnereiweiss vorkommende Mukoidsubstanz*), C. V. MÖRNER.—*Centbl. med. Wiss., 1893, p. 706; abs. in Chem. Centbl., 1894, I, No. 1, p. 57.*

On a mucoid substance occurring in egg albumen (*Ein im Hühnereiweiss vorkommende Mukoidsubstanz*), E. SALKOWSKI.—*Centbl. med. Wiss., 1893, pp. 706–708; abs. in Chem. Centbl., 1894, I, No. 1, p. 57.*

Qualitative and quantitative studies on the acidity of bread (*Hygienische Untersuchungen über Mehl und Brot; III. Qualitative und quantitative Untersuchungen über den Säuregehalt des Brotes*), K. B. LEHMANN.—*Arch. Hyg., 19, No. 4, pp. 363–409.*

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On the preparation of claires and the causes of the greening of oysters (*Conclusions relatives au parage des claires et aux causes du verdissement des Huîtres*), A. CHATIN and A. MUNTZ.—*Compt. Rend., 118 (1894), No. 2, pp. 56–68.*

A bacterial disease of eels (*La malattie dell' anguilla ed im bacello*), CANESTRINI.—*Abs. in Staz. Sper. Agr. Ital., 25 (1893), No. 1 and 2, p. 193.*

VETERINARY SCIENCE.

On abortion in cows (*Om kalvekastning*), I. NIELSEN.—*Landmandsvennen. 1 (1893), pp. 2, 13.*

Concerning the means of combating bovine tuberculosis (*Zur Bekämpfung der Tuberkulose, inbesondere beim Rinde*), TIEDEMANN.—*Fühling's landw. Ztg., 43 (1894), No. 2, pp. 41–44.*

On the association of bacteria in animal diseases (*Influence de certaines causes sur la réceptivité Associations bacteriennes*), V. GALTIER.—*Compt. Rend., 117 (1893), No. 26, pp. 1098, 1099.*

The failure of charbon virus injected under the skin of sensitive animals to act (*La destruction du virus charbonneux sous la peau des animaux sensibles*), J. SANARELLI.—*Ann. Inst. Pasteur, 7 (1893), No. 12, pp. 820–822.*

Researches on the influence of extracts from the thymus and testicles on charbon infection (*Recherches sur l'influence des extraits de thymus et des testicules sur l'infection charbonneuse*), A. GRAMATCHIKOFF.—*Ann. Inst. Pasteur, 7 (1893), No. 12, pp. 812–819.*

Some facts relative to the injection into animals of organic liquids (*Sur quelques faits relatifs aux effets des injections des liquides organiques chez les animaux*), E. MEYER.—*Compt. Rend., 117 (1893), No. 22, pp. 737–739.*

A contribution to the study of trichina (*Contribution a l'étude de la trichinose*), P. CERFONTAINE.—*Bul. Roy. Acad. Belgique, 25 (1893), ser. 3, pp. 464–488, plate 1.*

DAIRYING.

"Albumose" milk (*Albumosenmilch*), HAUSER.—*Berl. Molk. Ztg., 1893, p. 28; abs. in Vierteljahr. Chem. Nahr. und Genussmtl., 8 (1893), No. 3, p. 213.*

Examination of the milk of sixteen cows at Kleinhof-Tapiau (*Mitteilungen über die Untersuchungen der Milch von sechzehn einzeln Kühen der Herde Kleinhof-Tapiau*), HITTCHER.—*Milch Ztg., 22 (1893), No. 52, pp. 849–951.*

Removal of part of the lime from milk to render it more digestible (*Die teilweise Entkalkung der Milch*), A. E. WRIGHT.—*Apoth. Ztg., 8, p. 561; abs. in Chem. Centbl., 1894, I, No. 2, p. 92.*

Some minor improvements in Thörner's milk-tester (*Ueber einige kleine Verbesserungen am Milchwertmesser von Dr. Thörner, Osnabrück*), W. THÖRNER.—*Milch Ztg., 23 (1894), No. 2, pp. 25, 26, fig. 1.*

A new method for determining fat in milk (*Eine neue Methode der Milchfettbestimmung*), B. F. KIJANOWSKY.—*Pharm. Ztschr. für Russland, 32, pp. 693, 694; abs. in Chem. Centbl., 1894, I, No. 2, p. 117, fig. 1.*

Preservation of milk with sodium fluoride (*Versuche zur Conservirung der Milch durch Fluornatrium*).—*Ber. milchw. Instituts Proskau; abs. in Molk. Ztg., 1893, p. 32; and in Vierteljahr. Chem. Nahr. und Genussmtl., 8 (1893), No. 2, p. 219.*

Concerning the influence of mineral poisons on lactic fermentation (*Sur de l'influence des poisons mineraux sur la fermentation lactique*), A. CHASSEVANT and C. RICHET.—*Compt. Rend., 117 (1893), No. 20, pp. 673–676.*

Changes in the content of volatile fatty acids as butter becomes rancid (*Ueber die Veränderung im Gehalte an flüchtigen Fettsäuren beim Ranzigwerden des Butterfettes*), E. VON RAUMER.—*Forschungsber. ü. Lebensmittel, 1, pp. 22, 23; abs. in Chem. Centbl., 1894, I, No. 2, p. 118.*

Studies on the rancidity of butter (*Untersuchungen über die Ranzidität der Butter unter Berücksichtigung der Marktverhältnisse zu Halle a. S.*), SIGISMUND.—*Molk. Ztg., 8 (1894), No. 1, p. 3.*

On the ripening of cheese (*Contribute all'indagine della maturazione del formaggio*), A. BAUMANN.—*Abs. in Staz. Sper. Agr. Ital., 25 (1893), No. 1 and 2, pp. 166, 167.*

Sicilian cheeses, their manufacture and composition, SPICA and BLASI.—*Staz. Sper. Agr. Ital., 23, pp. 133–153; abs. in Molk. Ztg., 7 (1893), No. 53, p. 707.*

TECHNOLOGY.

Mechanical losses in cooking sugar juices (*Die mechanischen Zuckerverluste beim Eindampfen und Einkochen der Zuckersäfte*), BRETON.—*Bul. Assn. Chim., 1893, p. 850; abs. in Braunschw. landw. Ztg., 31 (1893), No. 52, p. 791.*

Treatment of beet chips with heated air (*Behandlung der Rübenschnitzel mit erhitzter Luft von dem Einbrungen in die Duffuseure*), J. DZIEGIELOWSKY.—*Abs. in Wochenschr. Cent. Ver. Rubenz. Ind., 31 (1893), No. 52, pp. 790, 791.*

Concerning the refining of diffusion juice by means of magnesia (*Ueber die Läuterung des Diffusionsaftes mittelzt Magnesia*), K. ANDRLIK.—*Ztschr. Zuckerind. Böh., 1893, p. 106; abs. in Wochenschr. Cent. Ver. Rübenz. Ind., 31 (1893), No. 52, p. 791.*

On the composition of wine of Moscato di Canelli (*Sulla composizione del Moscato di Canelli*), E. SILVA.—*Staz. Sper. Agr. Ital., 25 (1893), No. 1 and 2, p. 130.*

Researches on the antiseptic abrastol in wines (*Recherche de l'abrastol dans les vins*), SANGLÉ-FERRIÈRE.—*Compt. Rend., 117 (1893), No. 23, pp. 796, 797.*

A contribution to the study of the ferments of wine (*Contributione allo studio die fermenti del vino*), G. CUBONI and A. PIZZIGONI.—*Staz. Sper. Agr. Ital., 25 (1893), No. 1 and 2, pp. 7–19, plates 2.*

Concerning the addition of acids to must and wine (*Intorno all'aggiunta di acidi ai mosti ed ai vini*), A. FONSECA and T. CHIAROMONTE.—*Staz. Sper. Agr. Ital., 25 (1893), No. 1 and 2, pp. 20–44.*

Concerning a new method of concentrating must (*Progretto per un nuovo metodo di concentrazione di mosti*), M. SPICA and C. FERRARO.—*Staz. Sper. Agr. Ital., 25 (1893), No. 1 and 2, pp. 45–59, plates 2.*

Centrifugal treatment of must (*La centrifugazione del mosto d'uva*), C. FORTI.—*Abs. in Staz. Sper. Ital., 25 (1893), No. 1 and 2, pp. 185, 186.*

Improvement of oils by electric treatment (*Amélioration des huiles de consummation et des huiles de graissage, par un traitement électrique*), L. A. LEVAT.—*Compt. Rend., 117 (1893), No. 22, p. 734.*

AGRICULTURAL ENGINEERING.

Dynamometer experiments with vehicles differently loaded and hitched (*Zur Frage der vorteilhaftesten Belastung und Bespannung unserer Fuhrwerke*), H. REINHARDT.—*Deut. landw. Presse, 21 (1894), No. 2, pp. 13–15, figs. 4.*

Irrigation in Washington State (*Aus amerikanischen Bewässerungswirtschaften*), T. MUELLER.—*Deut. landw. Presse, 21 (1894), No. 4, p. 28, figs. 3.*

EXPERIMENT STATION NOTES.

MASSACHUSETTS STATIONS.—The question of uniting the two stations under one board of control and one director is being considered. The union is approved of both by the trustees of the Hatch Station and by the board of control of the State Station A committee of the two bodies has drafted a bill providing for uniting the two institutions, which will be presented to the State legislature this session.

NEW HAMPSHIRE STATION.—The new dairy building is being completed and will be ready for use in a short time. It will be equipped with a De Laval separator and the most approved machinery throughout. Coöperative fertilizer experiments will be conducted the coming season in each county in the State if suitable persons can be interested in the matter. The subject of local weather predictions is receiving attention with a view to assisting the Weather Bureau in reaching the farmers through the summer season.

OHIO STATE UNIVERSITY.—The students' association has recently published an illustrated pamphlet of 20 pages calling attention to the facilities for agricultural education at the university. Outlines are given of the short course in agriculture, and of the regular courses in agriculture, and horticulture and forestry. Particular attention is called to the fact that a scholarship may be given by each county in the State. In addition to the regular classroom instruction the university offers this year during, February and March, a series of lectures by prominent agriculturists of the State.

TEXAS STATION.—Mr. James Clayton, who for the past five years has been connected with the Alabama College and Station at Auburn as assistant in agriculture and horticulture, has been elected associate professor of agriculture of this college and agriculturist to this station. He entered upon his new duties January 1, 1894.

REVIEW OF WEATHER CONDITIONS IN IOWA, 1893.—In the monthly review of the Iowa weather and crop service (December, 1893), L. Roberts gives a detailed summary of meteorological conditions in Iowa in 1893, which shows that temperature, cloudiness, rainfall, and wind have been about normal, and as a result the year has been satisfactorily prolific in food products and favorable to health.

The following table shows the normals for temperature, rainfall, and movement of wind in Iowa for fifteen years:

Temperature, rainfall, and movement of wind.

Years.	Temperature.	Rainfall.	Wind movement.
	Degrees.	*Inches.*	*Miles.*
1879	46.7	34.18	....
1880	47.1	36.18	....
1881	46.2	41.17	....
1882	47.3	41.18	61,460
1883	44.0	38.71	63,560
1884	45.7	43.40	54,440
1885	43.9	38.21	54,490
1886	45.6	28.71	49,260
1887	47.2	34.01	53,110
1888	45.1	35.80	56,295
1889	48.1	31.98	49,720
1890	48.6	32.62	51,890
1891	48.5	33.87	48,625
1892	46.4	40.73	43,890
1893	46.2	30.39	51,660
Means	46.4	36.07	53,195

FERTILIZER INSPECTION IN MISSISSIPPI.—Bulletin No. 3 (January, 1894) of the Mississippi Agricultural College, by W. L. Hutchinson, State chemist, gives notes on valuations, tabulated analyses and valuations of thirty-two samples of fertilizing materials, including bone, bat guano, acid phosphate, kainit, and compound fertilizers collected during the season of 1893–'94; and a list of guaranteed analyses filed by fertilizer dealers in the office of the State chemist.

INSPECTION AND ANALYSES OF FERTILIZERS IN GEORGIA.—Bulletin No. 26 (second ser., pp. 63), issued by R. T. Nesbitt, commissioner of agriculture of Georgia, and G. F. Payne, State chemist, gives notes on valuation of fertilizers; a report on examinations of "Paine's Nonacid Phosphate," and finely ground "floats," and of samples of kerosene oil, with reference to their quality for illuminating purposes; determination of free sulphuric acid in acid phosphates; the texts of the laws relating to fertilizers in Georgia, with comments; and tabulated analyses of about 1,300 samples of various fertilizing materials, minerals, etc., including compound fertilizers, acid phosphate, bone, kainit, muriate of potash, sulphate of potash, sulphate of ammonia, cotton-seed meal, plaster, mineral phosphates, ores, clay, etc., examined up to June 30, 1893; and tables showing the number of brands and the average composition of fertilizers examined during each year since 1874.

FERTILIZER EXPERIMENTS IN NORTH WALES.—As a part of the scheme of agricultural instruction for the county of Montgomery, the University College of North Wales carried out in 1893 field experiments with manures for pasture land in two different localities. The results of these experiments are given in a bulletin of the agricultural department of the University College of North Wales, Bangor, together with notes on the functions, composition, and valuation of manures and on manures for various crops, by D. A. Gilchrist, lecturer in agriculture.

ADULTERATIONS OF FOOD STUFFS.—In the *Journal of the Royal Agricultural Society of England, 4 (1893), No. 16*, there are notes on the adulteration of linseed cake with rice meal and of cotton-seed cake with castor bean and sand. In one sample of adulterated linseed cake only 1.5 per cent was linseed meal, while 17 per cent was rice meal.

Three samples of cotton-seed cake containing the husk of castor bean were sent in by farmers who had used this as a feeding stuff. In all three cases the animals so fed had become ill.

TRAVELING DAIRIES IN CANADA.—The *Annual Report of the Ontario Agl. College and Exptl. Farm for 1892 (pp. 221–234)* contains an account of the work of three traveling dairies, sent out by order of the minister of agriculture. This work of instruction by traveling dairies was commenced in 1891, and was an outgrowth of the popular work of the faculty of the college. In 1892 the instructors commenced their work early in May, each having a separate territory to cover. One instructor was sent through the French-speaking districts. Each instructor was accompanied by competent assistants. Lectures or practical illustrated talks were given in various places, usually under the patronage of the local farmers' institute, who attended to advertising, etc., the instructors, with outfit, driving from place to place. The work was continued until the middle of December. Meetings were held in over three hundred different places in thirty-two counties.

The outfit of each traveling dairy consisted of "an eight-bottle Babcock milk-tester, a 'Daisy' churn, No. 2, lever butter-worker scales, butter print, ladles, cream cans, setting cans, cold water box, pails, salt, etc., in fact, everything required to make good butter, except cream, ice, and water. These were supplied by persons near the different places."

The instructors found it necessary to explain that they were not agents for any of the implements used, had no patent process of making butter, and were not trying to induce farmers to make butter at home instead of sending the milk to factories, but had simply come to discuss the matter and help those interested in dairying in every way possible. In some cases copies of a pamphlet, entitled "Hints on butter making," were given away at the meetings.

In regard to the Babcock milk test one of the instructors says:

"One of the most important parts of the apparatus we carried with us was the Babcock tester. It is really marvelous what an interest this tester has created throughout the country. And rightly, for it is designed to work a vast change in dairy farming in the next few years.

"People were invited in the posters or bills to bring samples of milk to the meetings. This they did, and sometimes in such numbers that it was found necessary to test many after the meetings were over. The highest number of samples brought to one meeting was eighty-six.

"Four points were mentioned in referring to this tester:

"(1) Its use in cheese factories as a means whereby to pay patrons according to the quality of the milk.

"(2) Its use in testing individual cows so as to weed out the unprofitable ones.

"(3) Its value in pointing out the effect on the milk of different feeds, harsh treatment, exposure, etc.

"(4) Its use in testing the skim milk, buttermilk, or whey, to note and correct the losses that might occur.

"The number of samples of milk tested amounted to over 2,000. * * * The difference between the production of the poorest and best cows was 0.6 of a pound of fat or slightly over 0.7 of a pound of butter per day. * * *

"After carrying on this work of testing the milk cows in different parts of the province I am more than ever convinced of the need there is for the dairyman to devote especial attention to this part of his business. Four things seem necessary: (1) To provide warmer stables, (2) to feed better, (3) to breed with more care, (4) to keep continually testing and weeding out the poor cows."

Another instructor gives his experience with the tester as follows:

"Samples of milk have been tested at nearly all the meetings, the largest number in any one day being at Erin, where sixty tests were made. In all, 1,685 samples were tested during the season, mostly whole milk, but a few samples of skim milk and buttermilk were also tested, and if the samples of the two latter that have been brought to us this summer are an average of the skimming and churning the people generally are doing, between a quarter and a third of the butter is being thrown away in the buttermilk and skim milk. In fact, if the farmer had only four or five cows and had a Babcock tester, and used it and followed its teachings intelligently, the saving on this item alone would pay for two or three testers in a year. * * *

"It would seem, not from what people say, but from what they are doing, that many persons kept cows for the fun of it, or because some other person kept cows. In 1,685 tests made, only five or six persons could tell definitely how much milk their cows were giving in a day, let alone in a year. Such indifference to business methods in farm work, and the consequent ignorance of what the individual factors of the farm are doing, has very much to do with the unsatisfactory position of many farmers.

"One half the cows of the country are living off the farmer, instead of the farmer off them, and an account opened with the butcher for the carcasses of the same would add materially to the wealth of their owners."

The work of these traveling dairies is said to have been of great practical benefit to many farmers in the counties visited, and "has done much to awaken an intense interest in dairying throughout all parts of the province." The annual cost of the enterprise is about $5,500.

Experiments in creaming milk on the Island of Jersey.—The Royal Jersey Agricultural and Horticultural Society, in a report of the dairy committee, gives the results of two trials made in creaming milk. In each case milk was creamed with an Alpha separator, and by setting in shallow pans, in "deep crocks," in a Jersey creamer, and in a Cooley creamer. The cream raised by each system was churned and made into butter and the butter yield was taken as an indication of the efficiency of the system. The best results were obtained with the separator,

and the next best results with the "deep crocks" and the Jersey creamer. The Cooley creamer gave little better results than setting in shallow pans, although it is stated that this system was not given a fair trial, as the necessary supply of cold water was not at hand. The system is recommended only when very cold water or ice can be used.

DAIRY SCHOOLS IN NORTH WALES.—According to the Report for 1893 for the Agricultural Department of the University College of North Wales, the three college dairy schools are situated at Sylfaen, near Welshpool; at Lleweni Hall, near Denbigh; and at Bangor. Butter-making and the making of soft cheeses are taught at all the schools; Cheshire cheese-making at present only at Welshpool and Denbigh. The Bangor and Welshpool schools are the property of limited companies, formed under the auspices of the college. The college gives three kinds of certificates to the pupils attending the dairy schools, *i. e.*, (1) an ordinary certificate in butter-making, (2) an ordinary certificate in cheese-making, and (3) an advanced certificate in dairy-working, including both butter and cheese making. Candidates for the ordinary certificates in butter-making or in cheese-making are required to attend one of the dairy schools connected with the college for at least a fortnight of ten working days, and to pass a satisfactory examination (oral and practical) on the prescribed subjects for the certificates. Candidates for the advanced certificate in dairy work are required (1) to attend one of the schools connected with the college for a period of six weeks; (2) to go through a course of practical instruction in butter-making and cheese-making; (3) to attend such courses of lectures in agriculture as may be given in connection with the dairy school of which the candidate is a pupil; (4) to pass a practical examination in butter-making and cheese-making; (5) to pass a satisfactory examination in the subjects included in the syllabus of instruction for the various certificates. The pupils are examined not only on the results of the instruction they have received at the schools, but also on their practical knowledge of the work of a butter-making dairy or a cheese-making dairy, as the case may be; or, in the case of the advanced certificate, on their practical acquaintance with the management of a dairy farm.

The schools are open for instruction from April 1 to October 1. They are coeducational, and in most cases the female pupils predominate. Many of the latter are fitting themselves for dairy maids on large estates. Each school has a traveling school attached which gives instruction during the summer in cheese-making and butter-making in different places, the length of the course given at each place being from ten days to three weeks. Demonstrations are also given in a number of other places. Many favorable comments on the results of the work of these traveling dairies are printed in the report. They have called attention to the necessity of cleanliness in dairying, have led to the improvement of butter in many cases, and have increased the use of dairy implements and apparatus.

ALASKA.—In a report to the Commissioner of Education, recently issued, Sheldon Jackson, General Agent for Education in Alaska, recommends the establishment of an agricultural school and experiment station in Alaska similar to those now existing in nearly every State and Territory of the Union. He says: "Passing from northern Alaska, with its adaptation to reindeer-raising, we find the whole southern coast, stretching for thousands of miles, to possess a temperate climate. This is due to the 'Kuro-siwo' or 'Japan current' of the Pacific Ocean. In this 'temperate belt' it is probable that there are areas of greater or less extent that are adapted to agriculture. At least, it is known that there are small farms or vegetable gardens on Kadiak and Afognak Islands, on the shores of Cook's Inlet, and in southeastern Alaska. It is also known that wild berries grow in great profusion and abundance in many sections. But no intelligent and continued experiments have been made to test the agricultural and horticultural capabilities of the country. * * *

"I would, therefore, recommend that an application be made to Congress to direct the Secretary of the Interior to extend to Alaska the benefits of the agricultural acts of 1887 and 1890, and secure the establishment of a school that can

introduce reindeer into that region, and teach their management, care, and propagation, and also to conduct a series of experiments to determine the agricultural capabilities of the country."

Among the lines of work which might be carried on he suggests "experiments extending over a term of years, to ascertain the vegetables, grains, grasses, berries, apples, plums, trees, flowers, etc., best adapted to the country; the best methods of cultivating, gathering, and curing the same; the planting and grafting of fruit trees; the development of the wild cranberry; cattle, hog, and poultry raising; butter and cheese making, etc."

Board of Agriculture of Great Britain.—The following popular leaflets were issued by the Board of Agriculture, London, during 1893: The black-currant mite (*Phytoptus ribis*), Farmers and the income tax, Cultivation of osiers, Insects on fruit trees, Mangel-wurzel fly (*Anthomia betae*), The field vole and its natural enemies, Autumn catch crops and fodder supply, Farmers and assessments to local rates, Ensilage, The ribbon-footed corn fly (*Chlorops Cœniopus*), Anthrax, The gooseberry saw-fly (*Nematus ribesii*), Alcorn poisoning, The raspberry moth (*Lampronia rubiella*), The apple blossom weevil (*Anthonomus pomorum*), The apple-sucker (*Psylla mali.*)

Royal Danish Agricultural Society, 1892–'93.—The Annual Report of this society for 1892–'93 (Copenhagen, 1893, pp. 132) contains a complete account of the activities of the society during the year 1892–'93. The number of active members was 778. According to the financial statement the expenses of the society amounted to $16,000. The money was expended for publishing important agricultural works; for the purchase of agricultural literature for distribution, especially to loan libraries; for holding conventions; for investigation in the various branches of agriculture, and their practical application; for premiums for special merit in farming operations; and for other objects tending to raise the standard of agriculture.

A feature of special interest is the education of young farmers in the practice of agriculture under the direction of this society. One hundred and eighteen farmers' sons over eighteen years of age were placed at sixty-five well-conducted farms in different parts of Denmark.

"Each one of these works for three years at three different farms, one year at each place, in order to widen his horizon by seeing agriculture in different regions of the country. While it is assumed that the owners of the farms will give him an opportunity for study during his spare hours, and also some assistance in order that he may properly understand the system of agriculture practiced; and while the society aids also in this direction by presenting the apprentices with a number of useful books, nevertheless their practical education is the main end sought. The object of the education of the apprentices is to teach them to work well and with thoughtfulness, and to observe and gather experience."

At the end of the three years the boys recommended by the farmers for whom they have worked receive a diploma from the society.

Botanical Report for New York.—Annual report of State Botanist C. H. Peck (*New York State Museum of Natural History, Annual Report for 1893, p. 42*).

The author gives a list of additions to the State herbarium, a list of contributors, a list of plants not before reported, with descriptions of 15 new species, mostly fungi, and a revision of the New York species of *Omphalia*.

Bulletins of the U. S. National Museum.—The following bulletins have recently been issued from the U. S. National Museum: Catalogue of the Lepidopterous super-family *Noctuidæ* found in Boreal America, with critical notes, J. B. Smith, Bulletin No. 44, pp. 424; A monograph of the North American Proctotrypidæ, north of Mexico, W. H. Ashmead, Bulletin No. 45, pp. 472; and The *Myriapoda* of North America, C. H. Bollman, Bulletin No. 46, pp. 210. The latter contains the collected writings on North American *Myriapoda*, published and unpublished, of the late C. H. Bollman, and is edited by L. M. Underwood.

MEMBRACIDÆ OF NORTH AMERICA.—F. W. Goding, in *Contributions from Illinois State Laboratory of Natural History* (pp. 391–482), gives a bibliographical and synonymical catalogue of the described *Membracidæ* of North America, including Mexico, Central America, and the West Indies. About 35 new species and varieties are described. Two new genera, *Evashmeadea* and *Vanduzea*, with three and four species each, are described.

RECENT ARTICLES BY STATION WORKERS.—The following articles by station workers have recently appeared: In *Botanical Gazette* (vol. XIX), Frost freaks of herbaceous plants, G. F. Atkinson, pp. 40–42; A hybrid *Baptisia*, A. S. Hitchcock, p. 42.

In *Torrey Bulletin* (vol. XXI), Two new grasses, *Panicularia laxa* and *Poach apmanniana*, F. Lamson-Scribner, pp. 37, 38; and *Puccinia menthæ* on variegated balm, B. D. Halsted, pp. 41, 42.

In *Journal American Chemical Society* (vol. XVI, No. 1), The chemical and physical investigation of soils, E. W. Hilgard, pp. 34–47.

LIST OF PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE.

FEBRUARY, 1894.

WEATHER BUREAU:

Monthly Weather Review, December, 1893.

DIVISION OF ENTOMOLOGY:

Insect Life, vol. VI, No. 3, January, 1894.

OFFICE OF EXPERIMENT STATIONS:

Experiment Station Record, vol. V, No. 5.

DIVISION OF STATISTICS:

Report No. 112 (new series), January–February, 1894. Report of the Statistician.

LIST OF STATION PUBLICATIONS RECEIVED BY THE OFFICE OF EXPERIMENT STATIONS.

FEBRUARY, 1894.

AGRICULTURAL EXPERIMENT STATION OF THE AGRICULTURAL AND MECHANICAL COLLEGE OF ALABAMA:
- Sixth Annual Report, 1893.
- Bulletin No. 52, January, 1894.—Corn and Cotton.

COLORADO AGRICULTURAL EXPERIMENT STATION:
- Fifth Annual Report, 1892.
- Bulletin No. 26, February, 1894.—Farm and Garden Notes for 1893; Seeding, Tillage, and Irrigation.

THE CONNECTICUT AGRICULTURAL EXPERIMENT STATION:
- Annual Report for 1893, part I.—Fertilizers.

FLORIDA AGRICULTURAL EXPERIMENT STATION:
- Bulletin No. 21, October, 1893.—The Tomato and Some of Its Diseases.

AGRICULTURAL EXPERIMENT STATION OF THE UNIVERSITY OF ILLINOIS:
- Sixth Annual Report, 1892-'93.
- Bulletin No. 28, December, 1893.—Grapes—Test of Varieties, a Disease, Method of Training.
- Bulletin No. 29, December, 1893.—Orange Rust in Raspberries and Blackberries; A New Factor in Scientific Agriculture.

KENTUCKY AGRICULTURAL EXPERIMENT STATION:
- Bulletin No. 47, December, 1893.—The Pests of Shade and Ornamental Trees; An Experiment on Plum Rot.
- Bulletin No. 48, January, 1894.—Commercial Fertilizers.

LOUISIANA AGRICULTURAL EXPERIMENT STATIONS:
- Bulletin No. 23 (second series), November, 1893.—Analyses of Commercial Fertilizers.

HATCH EXPERIMENT STATION OF THE MASSACHUSETTS AGRICULTURAL COLLEGE:
- Meteorological Bulletin No. 61, January, 1894.

AGRICULTURAL EXPERIMENT STATION OF THE UNIVERSITY OF MINNESOTA:
- Bulletin No. 29, December, 1893.—Wheat.
- Bulletin No. 30, December, 1893.—Soils.

MISSISSIPPI AGRICULTURAL EXPERIMENT STATION:
- Bulletin No. 27, November, 1893.—Insecticides and Their Application.

AGRICULTURAL EXPERIMENT STATION OF NEBRASKA:
- Seventh Annual Report, 1893.
- Bulletin No. 32, February 7, 1894.—Wheat and Some of Its Products.

AGRICULTURAL EXPERIMENT STATION OF NEW MEXICO:
- Bulletin No. 10, September, 1893.—Insects of 1893.
- Bulletin No. 11, October, 1893.—Notes on Cañaigre; Meteorological Data and Deductions.

NEW YORK AGRICULTURAL EXPERIMENT STATION:
- Bulletin No. 62 (new series), December, 1893.—Investigations Relating to the Manufacture of Cheese, part III.

Bulletin No. 63 (new series), December, 1893.—Some Experiences with Blackberries, Dewberries, and Raspberries.

Bulletin No. 64 (new series), January, 1894.—Some Experiences with Strawberries; Strawberry Crosses.

Bulletin No. 65 (new series), January, 1894.—Investigations Relating to the Manufacture of Cheese, part IV.

CORNELL UNIVERSITY AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 61, December, 1893.—Sundry Investigations of the Year.

NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 93*d*, December 30, 1893.—Meteorological Summary for December, 1893.

Bulletin No. 94, January 1, 1894.—Horticultural Tests and Results with Garden Vegetables, Fruits, and Bulb Culture.

TEXAS AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 28, December, 1893.—Sweet Potatoes.

AGRICULTURAL EXPERIMENT STATION OF THE UNIVERSITY OF WISCONSIN:

Bulletin No, 38, January, 1894.—One Hundred American Rations for Dairy Cows.

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The following publications have been issued:

Experiment Station Record, vol. I, 6 numbers; vol. II, 12 numbers; vol. III, 12 numbers and index; vol. IV, 12 numbers, including index; vol. V, Nos. 1–6. Copies of the Station and Department publications abstracted in the Record can, in many instances, be obtained on application.

Bulletins.—No. 1, Organization and History of the Stations; No. 2, Digest of Annual Reports of the Stations for 1888, in two parts; No. 3, Report of Meeting of Horticulturists at Columbus, Ohio, June, 1889; No. 4, List of Station Horticulturists and Outline of their Work; No. 5, Organization Lists of Stations and Colleges, March, 1890; No. 6, List of Station Botanists and Outline of their Work; No. 7, Proceedings of the Fifth Annual Convention of the Association of American Agricultural Colleges and Experiment Stations, Washington, D. C., August, 1891; No. 8, Lectures on Investigations at Rothamsted Experimental Station; No. 9, The Fermentations of Milk; No. 10, Meteorological Work for Agricultural Institutions; No. 11, A Compilation of Analyses of American Feeding Stuffs; No. 12, Organization Lists of the Agricultural Experiment Stations and Agricultural Schools and Colleges in the United States, June, 1892; No. 13, Organization Lists of the Agricultural Experiment Stations and Agricultural Schools and Colleges in the United States, April, 1893; No. 14, Proceedings of a Convention of the National League for Good Roads, January, 1893; No. 15, Handbook of Experiment Station Work; No. 16, Proceedings of the Sixth Annual Convention of the Association of American Agricultural Colleges and Experiment Stations, New Orleans, Louisiana, November, 1892; No. 17, Suggestions for the Establishment of Food Laboratories; No. 18, Assimilation of Free Atmospheric Nitrogen by White and Black Mustard; No. 19, Organization Lists of the Agricultural Experiment Stations and Agricultural Schools and Colleges in the United States, January, 1894.

Miscellaneous Bulletins.—No. 1, Proceedings of Knoxville Convention of Association of Agricultural Colleges and Stations, January, 1889; No. 2, Proceedings of Washington Convention of the Association, November, 1889; No. 3, Proceedings of Champaign Convention of the Association, November, 1890. (Series discontinued.)

Farmers' Bulletins.—No. 1, The What and Why of Agricultural Experiment Stations; No. 2, Illustrations of the Work of the Stations; No. 9, Milk Fermentations and their Relation to Dairying; No. 11, The Rape Plant.

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The Agricultural Experiment Stations in the United States.

R. Kent Beattie

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U. S. DEPARTMENT OF AGRICULTURE

OFFICE OF EXPERIMENT STATIONS

Vol. V No. 8

EXPERIMENT STATION

RECORD

PUBLISHED BY AUTHORITY OF THE SECRETARY OF AGRICULTURE

WASHINGTON
GOVERNMENT PRINTING OFFICE
1894

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U. S. DEPARTMENT OF AGRICULTURE

OFFICE OF EXPERIMENT STATIONS

Vol. V No. 8

EXPERIMENT STATION RECORD

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EXPERIMENT STATION RECORD.

Vol. V. No. 8.

The Fertilizers and Feeding Stuffs Act, which was enacted by the English Parliament September 22 of last year, went into effect January 1. This act affords English farmers a protection in the purchase of fertilizers and feeding stuffs by requiring the seller to give an invoice stating the nature of the article sold, and, in the case of fertilizers, the composition. This invoice is in effect a guaranty and is so regarded by the courts.

For many years the Royal Agricultural Society has urged that manufactured fertilizers and feeding stuffs should be bought and sold on a guaranty of composition and purity, and has maintained a laboratory where its members could have such materials tested on payment of a small fee. In 1872 it published a series of blank forms to be used in buying these materials. These blanks were a form of guaranty to be signed by the seller, and stated the composition in the case of fertilizers, and the character and purity in the case of feeding stuffs.

The present law follows out the suggestions of the Royal Agricultural Society in requiring a guaranty to be given, and provides analysts to test goods for purchasers at the latter's expense. The law applies only to manufactured goods or those which "have been subjected to any artificial process."

The section relating to fertilizers provides that in sales of over 50 pounds the seller shall furnish the purchaser with a statement as to the name of the article, whether it is an artificially compounded article, and the percentage, at least, of the nitrogen, soluble and insoluble phosphates, and potash.

The section on feeding stuffs calls for an invoice giving the name and nature of the article, but not necessarily the composition. The invoice must state the material or materials from which the feeding stuff is made, and guarantee that no other substances or seeds have entered into its composition. The sale of any article for use as food for cattle implies a warranty by the seller that the article is suitable for feeding purposes.

Any statements regarding the percentage of nutrients made in the invoice or in any circular or advertisement have the effect of a guaranty.

Failure to furnish the invoice of the goods, the addition to a feeding stuff of any deleterious material, or the delivery of goods inferior to those described in the invoice, renders the seller liable to a fine of £20 for the first offense and of £50 for each subsequent offense.

The details of the execution of the law are left to the Board of Agriculture. A chief analyst is to be appointed by this board, to be paid from the national treasury; and district analysts are to be appointed by each county council or by several combining. The district analysts are subject to the approval of the Board of Agriculture, but are paid by their respective constituents.

Any person may have goods analyzed by the analyst of his district by paying a fee fixed by the county council. In sampling goods for analysis three separate portions are taken—one for the analyst, one for the seller, and one to be retained by the purchaser. A penalty is provided for tampering with samples taken or with goods in such a way as to hinder the taking of a fair average sample.

In case of dissatisfaction with the results of the district analyst, appeal may be taken to the chief analyst by paying an additional fee. The expense of having goods tested is borne by the defeated party.

Prosecution under this act can not be instituted except on a certificate by the Board of Agriculture that there is reasonable ground for prosecution. The act applies to Scotland and Ireland also, in Ireland the Lord Lieutenant acting in the capacity of the Board of Agriculture.

The new English law, so far as it relates to fertilizers, stands midway between the "fertilizer control" prevailing in several European countries and the fertilizer laws of various States in this country.

The fertilizer laws in this country all require that each package of fertilizer shall bear a label stating the name of the fertilizer and its composition, and most of the laws imply an inspection of the markets of the State to see that the goods sold agree in composition with the guaranty. This inspection is usually maintained from license fees or analysis fees paid by fertilizer manufacturers or dealers.

Where no regular inspection exists each manufacturer or dealer is required to file a certified analysis or sample of each brand of goods he intends to sell before a license can be procured. The original analyses or those of the samples furnished are published. Penalties are provided for fraud or failure to comply with the law.

In some States any farmer may have a fertilizer analyzed without cost by the chemist charged with the inspection, by taking samples according to directions sent him. In no State is the farmer taxed or charged directly for the fertilizer inspection and regulations or the protection which they afford him.

The fertilizer control, on the other hand, as practiced in Germany, is independent of any specific law. It is a voluntary arrangement between the dealers and the station, in the interest of both the dealers and the

farmers. Dealers place their goods under the control of the local experiment station, agreeing to sell their goods under a guaranty and to indemnify the purchaser for any deficiency in composition. The station publishes the list of firms who have placed themselves under its control, and farmers prefer to deal with such firms. Farmers can have samples of fertilizers bought of these firms analyzed at the station for a small fee. If the goods are found below the guaranty in composition, the station calculates the indemnity. The Government takes no part in the matter further than to aid in the support of the experiment stations.

The English law requires the dealer to guarantee the composition of the goods he sells and makes him directly holden for their quality; but it provides no inspection of fertilizers except a voluntary one paid for directly by the purchasers.

The English law resembles most closely the Belgian law, but it differs by not requiring a fee from the manufacturer or dealer. It affords more protection than the German fertilizer control, for the latter applies only to such dealers as voluntarily submit to control, but does not go as far as the laws of most of the States of this country. Each method may best serve the peculiar conditions of the country in which it is in force, but it is doubtful if the American farmer would profit to any great extent from a law requiring him to maintain his own inspection by the payment of fees of analysis.

The present number of the Record contains an account of the experiment station at Bernburg, Germany, and the method of sand culture there employed.

The article is a somewhat free translation by Prof. Atwater of an account prepared for the Record by Prof. Hellriegel, the director of the station, with the aid of two of his assistants, Dr. Wilfarth and Dr. Wimmer.

The Bernburg Station is of especial interest because it is the best equipped in the world for experiments in sand culture, and because here Prof. Hellriegel, with his associates, discovered the relation between microörganisms and the acquisition of atmospheric nitrogen by plants—perhaps the most important discovery in vegetable physiology, and certainly the most important one for agricultural science, that has been made in our generation.

Prof. Hellriegel has been engaged for more than a quarter of a century in developing the method of sand culture, and his work is a model of patient, scientific thoroughness. The consideration which has been chiefly efficient in leading to the development of the Bernburg Station and the method of sand culture is the fact that needed information regarding the feeding of plants, the use of fertilizers, and the various conditions of successful culture can not be obtained by field experiments, but must be sought in investigations in which the conditions

can be known and controlled. Sand culture is especially useful in such experiments, but its methods must be thoroughly understood in order to secure the best success.

The great art in such researches is to work with normal plants. When the factors of growth are known and under control and normal plants of definite size and development are produced, then and then only can the effect of change of a given condition be accurately tested. The only way to learn how to get such normal plants is to study each species by many trials under varied conditions. This may be the work of years for given kinds of plants; indeed it has been so in Prof. Hellriegel's experience.

Two things impress the appreciative visitor at the Bernburg Station—and the same things were manifest at the station at Dahme, of which Prof. Hellriegel was director before his removal to Bernburg. One is the infinite patience and thoroughness with which every detail is carried out, even though many years elapse before a definite result is gained. The other is the success attained in growing the plants and in finally reaching definite results. Only a small number of species of plants have been used for experiment, but the ways to grow them successfully have been so thoroughly studied that magnificent plants are obtained.

The method of sand culture as applied to the study of nitrogen assimilation will be described in the succeeding number of the Record.

THE EXPERIMENT STATION AT BERNBURG, GERMANY, AND ITS METHODS OF SAND CULTURE.

Prof. H. Hellriegel.

The recognition of the fact that the conditions upon which the growth of plants depend can not be completely studied by means of field experiments alone, led the Association of the Sugar Beet Industry of the German Empire to lay plans, in the seventies, for the foundation of an experiment station, the object of which should be to explain by scientific research such problems as were incapable of solution by field experiment alone. Such a station was afterward established at Bernburg by the Government of the duchy of Anhalt, with the coöperation of the above-mentioned association, and began its work on April 1, 1892.

The aim of the investigations of the station was to be the study of the laws of growth and nutrition of the most important agricultural plants, and especially the sugar beet. To this end it was deemed necessary to conduct the experiments in pots, so that the growth of the plant and everything pertaining to it might be closely watched.

To justify the drawing of general conclusions from such experiments, two things are requisite. The first is the evidence that the artificially grown plants are normal. The second is that the results be the direct consequence of a given set of experimental conditions. Two things are necessary to meet these requirements. One is a suitable place and the necessary equipment for the growing of plants. The other is a chemical laboratory. The Bernburg Station has both and, in addition, an experimental field where the results of the investigations in the laboratory may be put to a practical test.

The field experiments have less general interest than those in the vegetation house and will not be described here. The aim of the present paper is to give a detailed description of the experiment station, its equipment, and the method of sand culture which has been elaborated.

ORGANIZATION AND EQUIPMENT OF THE STATION.

The station is under the immediate control of the ducal Government of Anhalt. Its management and the selection of lines of investigation are placed in the hands of a board appointed for that purpose.

The officers of the station are: Director, Dr. H. Hellriegel; first assistant, Dr. H. Wilfarth; second assistant, Dr. H. Roemer; third assistant, Dr. G. Wimmer; fourth assistant, J. Peters; fifth assistant, Dr. H. Franke. There are also three laboratory helpers, making a total staff of nine persons.

BUILDINGS AND GROUNDS.

The land upon which the station is situated was placed at the disposal of the Government of the duchy for the station at the time of establishment of the latter. The chemical laboratory and the preparation room had been used as a schoolhouse and gymnasium, and only interior alterations were necessary.

A piece of land adjoining was purchased for a garden. Considerable expense was involved in filling up this land and in altering the old buildings and erecting new ones, so that the entire station, with its appliances and apparatus for plant experiments and the equipment of the laboratory, cost between $30,000 and $32,500 (120,000 to 130,000 marks). The greenhouse, which is made of glass and iron, cost $4,750 (19,000 marks); and the shed with the annex for weighing and watering plants cost $900. In the year 1892–'93 the subsidy of the station amounted to $6,250, of which $3,500 were supplied by the Government and $2,750 by associations and societies.

Laboratory.—The chemical laboratory occupies the ground floor of the main building, which is 165 feet long and 37 feet wide. There are three rooms devoted entirely to chemical operations, a balance room, a microscopic room, a photographic dark room, library, office, a room for the preparation of distilled water, and a storeroom for chemicals, making ten rooms in all. The apartments of the director of the station and two of his assistants occupy the second floor of the building, and the third floor is given up to the laboratory helpers.

The equipment is for the most part such as may be found elsewhere. Mention may be made, however, of a large drying oven with a capacity of about 1½ cubic yards. This oven is heated with coal and is used for drying quantities of various products, *e. g.*, samples of field crops too large to be placed in the ordinary ovens at a single time. Heated air is introduced at the bottom of the drying chamber and escapes through a flue at the top. All the small ovens are heated with gas, which is supplied from a single gasometer. This gasometer is filled every night with gas from the local gas works, which enables the pressure to be kept constant throughout the laboratory during the day.

Preparation room.—At the rear of the main building, at a distance of about 40 feet, is a building which formerly served as a gymnasium for the school, but is now used as a preparation room. This building, which is of massive stone, is 68 feet long, 43 feet wide, and 18 feet high. The floor is partly of plank and partly cement. Here all the culture pots are stored during the winter and filled with soil in the spring. There are also closets for storing large quantities of seeds and preserving plants which have been harvested from year to year. The larger part of the material used in field culture is also kept here. The building is supplied with arrangements for sterilizing large quantities of soil by means of fire as well as by steam. A kiln 10 feet long and 40 inches wide serves for the rapid drying of large quantities of soil or other

material. A spacious platform, 10 feet above the floor, is used for storing boxes, flasks, etc. The room may be heated, and, altogether, it is one of the most useful accessories of the station.

Grounds.—The diagram herewith (Fig. 12) shows the situation of the buildings and grounds of the station.

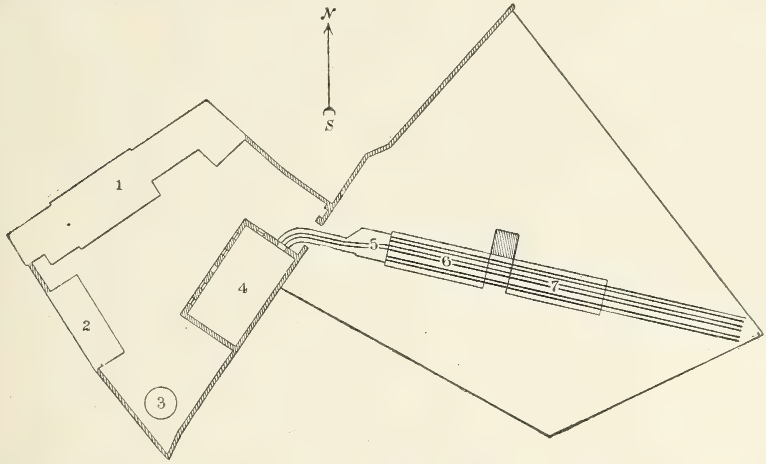

FIG. 12.—Plan of grounds of Bernburg Experiment Station.

1. Main building.
2. Storeroom.
3. Gasometer.
4. Preparation house.
5. Movable platform.
6. Shed.
7. Greenhouse.

The ground devoted to vegetation experiments is situated 160 feet east of the main building of the station, and extends to the river Saale, which flows through the town. Its dimensions are 50 by 250 feet, giving a plat of approximately 12,500 square feet. A gravel embankment gives the area an elevation of about 3 feet above the surface of the river at high water. Its longer dimension is from east to west. The space which is devoted to the culture experiments is ample for a large number of plants and is entirely open, and light and air have access.

The total space devoted to the experiments is divided into three principal parts, namely, the open plat or garden, the greenhouse, and a partially inclosed building or shed, used to protect the plants from the sun, rain, and hail. These three divisions extend from east to west in the order mentioned, and are connected with each other by three parallel car tracks which start from the preparation house, pass over an open space through the shed, and then through the greenhouse to the gardens. These tracks, which are 40 inches in width, facilitate the movement back and forth of the wagons which carry the pots containing the plants under experiment. The wagons can be easily pushed by hand through the entire place. Another track connects the open plat or vegetation garden directly with the preparation room, passing outside the shed and glasshouse. The space between the rails is boarded over.

Garden.—This lies at the eastern end and borders directly on the river. Its dimensions are 50 by 93 feet, giving a surface area of 4,650 square feet. With the exception of the western side, on which is the greenhouse, it is entirely open. The central part, which is occupied by the tracks, covers about 2,000 square feet. The rest of the plat is uncultivated and is kept as free from weeds as may be. This open plat, which furnishes the plants all the conditions of growth called for in experiments of the kind here made, is constantly occupied by pots of growing plants. The wagons, which are kept in the greenhouse over night, are rolled out at 6 o'clock in the morning and remain in the open air until late in the evening, unless winds or unusual heat make it desirable to move them to the cover of the greenhouse or shed. Violent winds and excessive heat occur very infrequently, but rain falls very often. On this account constant watch must be kept over the plants, for under certain conditions a single severe rainfall may render the results of an experiment worthless. As soon as rain, and especially thundershowers, threaten, the wagons are moved into the greenhouse.

Greenhouse.—This is of glass. Special pains have been taken in its construction in order that plants may remain in it for a long time without injurious effects. Rains may continue for a week at a time and then the plants must be kept in the house all the time. Only glass and

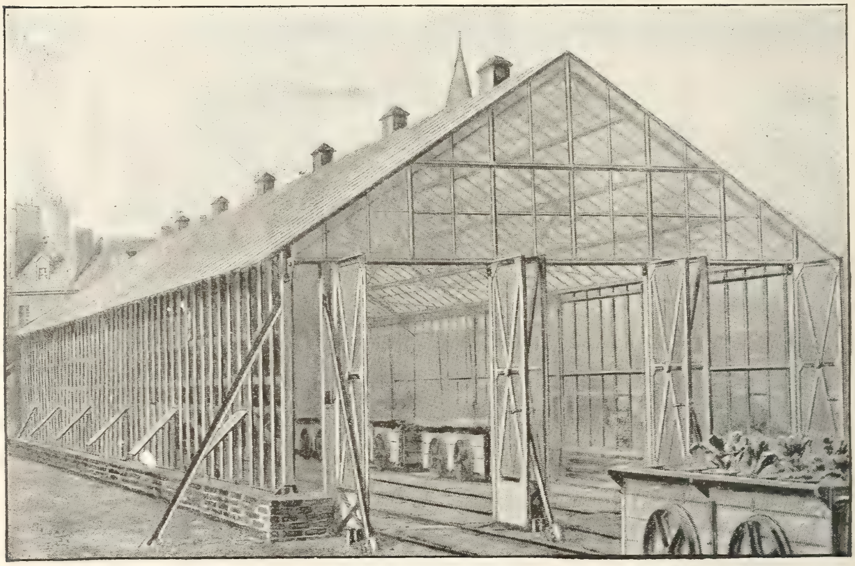

FIG. 13.—Greenhouse.

iron were used in the construction of the greenhouse, and the iron framing was made as slender as possible to avoid shading the plants (Fig. 13). The length of the greenhouse is83 feet and the breadth 23 feet, giving a floor area of about 1,900 square feet. Its height is 11 feet to the eaves and 18 feet to the ridge, giving an air capacity of nearly 1,000 cubic yards.

The east and west ends of the house are provided with folding doors, 10 feet in height, which fill almost the entire space, with the exception of the gable. These doors are generally open at night. The north and south sides are each provided with six ventilators placed 2 feet above the ground and 8 feet apart. Each of these apertures is 18 inches square, and the ventilators are kept constantly open in warm weather. There are also six adjustable ventilators in the roof, placed at a distance of 13 feet apart. By these contrivances a constant change of air is insured in the spacious interior of the building and at the same time a sufficient amount of light is admitted. When frosts are feared during the spring or fall the doors and all the ventilators are shut.

At the north end of the greenhouse on the west side is a small stone wing, originally intended as a place for watering the plants, but the heat was so intense on bright summer days that this work was transferred to the shed. It has been fitted up for photographic purposes. It is well equipped with photographic apparatus and appliances for the mounting or holding in place of objects to be photographed, and special contrivances for producing a suitable background and for regulating the light. The officers of the station have themselves photographed all plants which have grown successfully or proved in any way worthy of particular attention, and also the special apparatus and appliances, etc., used in the experiments. The dark room in the chemical laboratory, already mentioned, completes the equipment for photography.

On account of its high temperature, compared with that of the outside air, the greenhouse is well adapted for drying plants, moist soil, etc., during the fall and winter.

The shed.—This is a building with a low roof, open at the sides and ends (Fig. 14). It is not absolutely essential in vegetation experiments, but the plants are brought under it when the heat is so excessive that they are in danger of injury on account of the high temperature of the comparatively small pots in which they grow. Under these circumstances, the sand in the pots in which there is a luxuriant growth, and which ordinarily require a good deal of water, dries out quickly and almost completely, and frequent watering is necessary. The watering of a large number of such pots, if properly done, is by no means an easy task. For this reason the wagons are brought from the open garden under the cover of the shed when the thermometer reaches 120° F. in the sun before noon. Such extreme heat occurs in Bernburg rarely and during many summers not at all, and even when it does occur the building is used for the purpose only during the hottest hours of the day. This building is also of great use in hailstorms, as the glass of the greenhouse is liable to be broken by large hailstones. While the building is not a necessity for the plants, it is a great convenience in many other ways, and almost indispensable in experiments conducted on the scale of those here described. The care of several hundred

pots of experimental plants requires the labor of several men during the entire summer. A large part of this labor is done most advantageously on a place protected completely from rain and in part at least from wind.

This building is located immediately west of the greenhouse and joins the latter. It is 70 feet long and 42 feet wide. It consists of a roof made of roofing paper supported by twelve wooden posts 11 feet high with cross beams. The roof, which is nearly flat, projects 9 feet beyond the posts, and thus completely protects the space occupied by the tramways from rain. The extreme height of the roof in the middle is 14 feet.

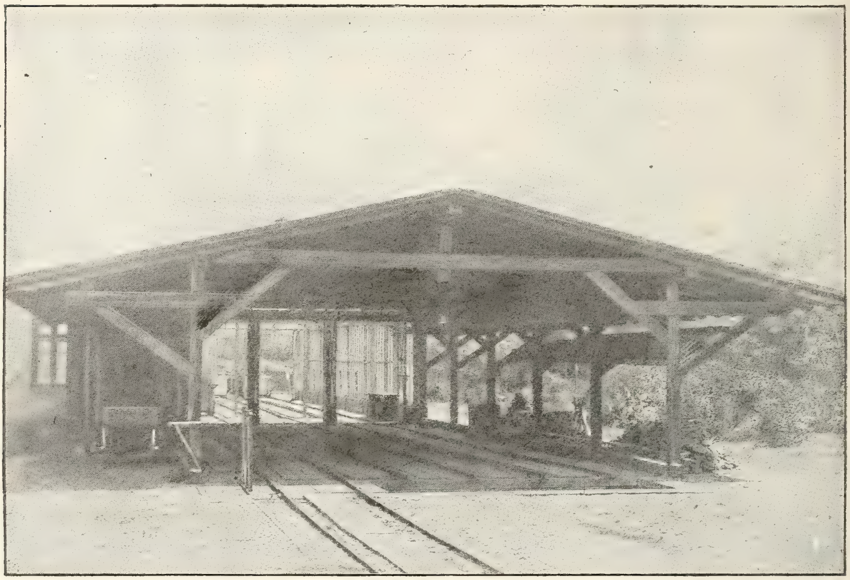

FIG. 14.—Shed for protecting plants from heat and storms.

At the west end of the building the tracks pass over a platform which moves laterally across them, making it easy to transfer the wagons from one track to another.

Watering room.—On the north side of the shed, at the end adjoining the greenhouse, is a wing somewhat smaller than the photographic room mentioned above. It is used for watering the plants. As will be seen later, the proportions of water in the culture pots must be carefully regulated. The judgment of the experimenter can not be relied upon for this purpose and it is necessary to weigh each pot before watering, so that the loss by evaporation may be accurately determined and the requisite amount of distilled water added. When we consider that in warm summer weather most of the plants have to be watered at least once and the more luxuriant ones twice a day, and that this

involves moving the wagons from the garden to the shed, taking out three hundred or three hundred and fifty pots, weighing them one by one, adding the needed quantity of water, putting them back in the wagons and returning them to the garden, the advantage of being able to work in the shade will be appreciated.

The watering room contains a desk in which the records of the watering and various other books are kept, a contrivance for holding vessels in which the water is contained and for measuring the water conveniently, scales for weighing the pots, and other accessories.

The shed also affords a very convenient place for harvesting the plants, collecting the soil materials, etc.

APPARATUS AND MATERIALS USED IN SAND CULTURE.

We now come to the description of the pots (Fig. 15) in which the plants are grown, the wagons in which the pots are held and transported, and the soil and nutritive solutions used.

Pots.—Of these three sizes are used. Cereal grains, peas, beans, and plants with small root development generally are grown in small pots, 9½ inches high and 6 inches in diameter at the top and 4 inches at the bottom. These pots hold 9 pounds of sand. For the lupines and other plants of like habits of growth, the pots used are 16 inches high, 6 inches in diameter at the top and 5½ inches at the bottom, and hold 17½ pounds of sand. The pots of both these sizes are of white glass. There is a hole in the bottom of each pot and the upper edge is bent outward for greater strength and to facilitate handling. The pots are covered on the outside with a layer of black and then with a layer of white paint. The white surface is desirable to reflect the sun's rays and prevent the sand and plants from being too much heated, but experience has shown that the light penetrates the white paint and algæ grow inside. The inner layer of black paint prevents this.

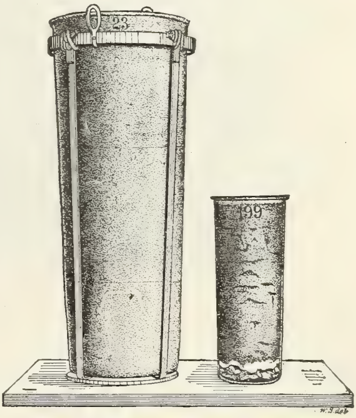

FIG. 15.—Pots used in sand culture.

The pots used in the sugar beet experiments are made of gray glazed earthenware. They are 32 inches in height, 11½ inches in diameter at the top, and 9½ inches at the bottom. The bottom contains four holes. The pots stand in iron frames provided at the top with a pair of handles, which are used in lifting them from the wagons by means of the crane before referred to.

Wagons.—The station has twelve four-wheeled wagons (Fig. 16) in which the pots are kept. The wagon boxes are made of wood and are 9½ feet long, 3 feet wide and 34 inches deep inside. The wheels are 28 inches in diameter. The axles are bent downward at right angles so that the box comes within 4 inches of the ground. By this contrivance even the tall pots used for the sugar beet cultures may be sunk so deeply that the tops reach only a little above the top of the wagon. The wagons are built so strongly that they run steadily when moved.

The arrangement of the pots in the wagons is such as to avoid too much exposure to the sun's rays and at the same time to prevent the plants from shading one another. For this purpose the pots are placed so that they project only a few centimeters above the edge of the box; this slight projection is needed to make it easier to get hold of them.

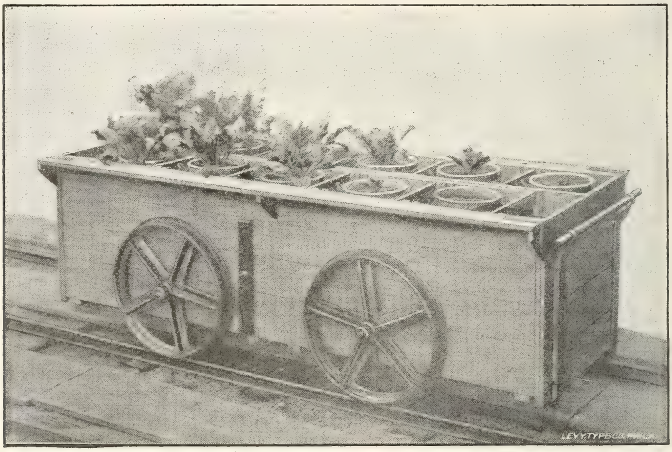

FIG. 16.—Wagons used for holding culture pots.

The pots are arranged in rows, each wagon containing either four rows of the smaller pots or two of the larger used in the sugar beet experiments. The several rows are separated by boards, which are easily put in or taken out and which serve both to hold the pots in place and to protect them from the sunlight. The pots are held at the desired height in the wagons by means of wooden stands. As many as sixty of the small pots may be placed in a single cart, provided the plants are small, or their growth is only upwards; but if the plants are large and especially if they tend to spread out during growth the maximum number put in one wagon is fifty. When the plants are large and spreading there is the greatest danger of their shading one another. On this account the smaller plants are placed in the first row on the south side of the wagon with the larger ones behind them, arranged in order of height. During the course of the season the position of the pots is frequently changed.

To prevent the depredations of birds the wagons are covered to a height of 5 feet with netting (Fig. 17).

The pots used for sugar beets are placed in two rows only in each wagon and each pot is separated from the others by easily adjustable boards. The divisions run crosswise of the cart, so that when the pots, which weigh about 130 pounds apiece, are removed in process of watering the least injury possible may be done to the foliage of the other plants.

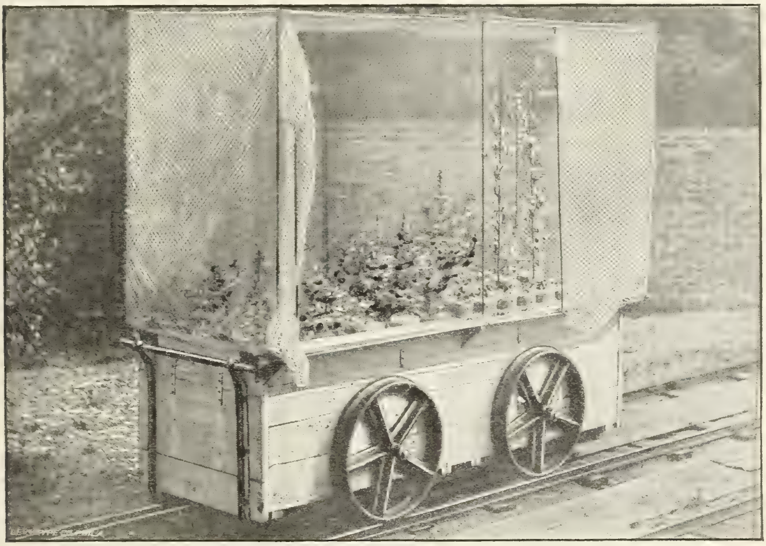

FIG. 17.—Netting used to protect plants from birds.

Sand.—Pure quartz sand is used for soil material. Except in experiments with sugar beets, in which the pots have to be so deep as to require the addition of some material to increase the water-holding capacity of the sand, and a few cases with certain other plants, as barley, peas, and lupines, no extraneous soil material is added. Only one kind of sand is used. This is a pure, white, glass sand from Hohenbocka, near Dresden, Saxony. It is composed of very uniform angular grains of quartz with only occasional particles of feldspar, mica, and hornblende. It contains extremely little iron. It is washed twice before shipment to Bernburg and is so free from clay and other material mechanically removable by water that the formation of a crust on the top is impossible. Out of a kilogram of this sand not more than 0.37 gram will pass through an ordinary 0.1 mm. sieve and only 0.82 gram is retained by one with a 0.5 mm. mesh. [A sample kindly furnished to the editor by Prof. Hellriegel was submitted to Prof. M. Whitney of the

Maryland Experiment Station for mechanical analysis, with the following result:

Mechanical analyses of a sample of sand used in sand cultures at the Bernburg Station.

Diameter of grains.	Conventional names.	Mechanical analysis.	Number of grains per gram.*	Surface area.†
Mm.		*Per cent.*		*Square cm.*
2–1	Fine gravel	0.00	0	0.0
1–0.5	Coarse sand	0.00	0	0.0
0.5–0.25	Medium sand	12.69	1.735	7.6
0.25–0.1	Fine sand	86.50	116,400	104.5
0.1–0.05	Very fine sand	0.77	13,160	2.3
0.05–0.01	Silt	0.00	0	0.0
0.01–0.005	Fine silt	0.00	0	0.0
0.005–0.0001	Clay	0.00	0	0.0
Total		99.96	131,295	114.4
Loss		0.04		
		100.00		

* Approximate number of grains in one gram.
† Approximate extent of surface area of these grains in sq. cm.

There was no appreciable amount of silt, fine silt, or clay.

Naturally the sand is not chemically pure. Analyses made in the Bernburg laboratory show that the following plant nutrients are dissolved from 1 kg. of sand by extracting three times with boiling concentrated hydrochloric acid:

	Gram.
Sulphuric acid	0.052
Chalk	0.080
Magnesia	0.030
Potash	0.014
Soda	0.067
Phosphoric acid	trace.

Although the sand itself is free from nitrogen, it always contains minute quantities from contamination with dust, especially after long storage. Following are the results of the large number of the nitrogen determinations made by the Kjeldahl method in different years. Forty grams were used for each determination. The figures in the first column show the nitrogen found in the freshly removed sand; those in the second column are for the sand after storage for a considerable time, in some instances several years:

Nitrogen per kilogram

In fresh sand.	In sand after storage.
Gram.	*Gram.*
0.0005	0.0039
0.0008	0.0032
0.0004	0.0036
	0.0031
	0.0046

The nitrogen content of the sand, even after a long period of storage, is so small that its influence on vegetation is scarcely, if at all, appreciable.

Water-holding capacity of the sand.—The capacity of the sand for holding water depends principally upon the depth of the pot, *i. e.*, the thickness of the stratum. Up to a height of 8 to 9½ inches the sand holds approximately 20 per cent of water. In pots 16 inches deep it holds only about 12 to 13 per cent. The deeper the pots are the smaller will be the percentage of water which the entire sand contains. On this account the water is not evenly distributed throughout the sand, the lower strata contain a comparatively large and the upper ones a comparatively small amount of water.

The tendency of the water to settle becomes so marked in the pots 32 inches high that plants will not thrive in the upper strata, even though watered so freely that it runs through the pot. This matter will be referred to again in speaking of the experiments with beets and the use of humus.

Water.—Special attention must be given to the preparation of pure distilled water. Such large quantities are used during the period of growth that an amount of impurity which might otherwise be neglected may become a source of considerable error. For this reason, the station prepares its own distilled water, using a copper still and condenser. The first third of the distillate is rejected because of the possibility of its containing ammonia. The water is tested very frequently and must be free from chlorine and compounds of nitrogen.

Nutritive solutions.—The fertilizing materials required for the growth of the plants are given in form of solutions when possible. The solutions are made up according to the following figures, which show the strength of the solutions as actually prepared and kept for use:

Strength of nutritive solutions.

Names of solution.	1 c. c. solution contains—	Corresponding to—
KCl	0.0745 grm.	39 mgrm. K.
K_2SO_4	0.0870 grm.	39 mgrm. K.
KNO_3	0.1010 grm.	39 mgrm. K. 14 mgrm. N.
$Ca(NO_3)_2$	0.820 grm.	14 mgrm. N.
NH_4NO_3	0.0800 grm.	28 mgrm. N.

One cubic centimeter of all phosphoric acid salt solutions contains 71 millograms of P_2O_5; *e. g.:*

Strength of phosphoric acid solutions.

Name of solution.	1 c. c. solution contains—	Corresponding to—
KH_2PO_4	0.136 grm.	71 mg. P_2O_5, 39 mgrm. K.
K_2HPO_4	0.174 grm.	71 mg. P_2O_5, 78 mgrm. K.
$CaH_4(P_2O_4)_2$	0.117 grm.	71 mg. P_2O_5, 20 mgrm. Ca.

By use of nutritive solutions of such composition it is very easy to produce any desired combinations of plant food and readily to substitute one for another.

Chemically pure salts only are used in the preparation of the nutritive solutions. The purity of the salts is tested from time to time by chemical analysis. The solutions are made up to the required strength and then analyzed a second time. The solutions, when ready for use, are stored in glass bottles.

FILLING THE POTS.

As a rule sand is used only in pots of the two smaller sizes, namely, those holding 9 and 17½ pounds. Only these will be referred to here, as the filling of the largest pots will be more conveniently described in connection with the description of the experiments with sugar beets, for which they are used.

Unless the nature of the experiment requires a special process of purification or sterilization the sand is simply passed through a 0.5 mm. sieve, and then either 9 or 17½ pounds are weighed out and the nutritive solutions are added. The solutions are measured from accurate burettes. Solutions which are to be used in a given pot may be measured out into a single flask, unless precipitates are formed. The latter method is usually followed, since phosphoric acid is commonly supplied in the form of the basic salts. The phosphoric acid solutions are diluted to 200 c.c. and the other solutions to 300 c.c. with distilled water. Immediately before filling the pots the two solutions are put together, and 200 c.c. of distilled water added for the 9 pound pots or 400 c.c. for 17½ pound pots. The solutions are then added to the sand, which has been previously weighed out into a large porcelain or enameled ironware dish, and thoroughly mixed with it. If solid plant food, as for instance calcium carbonate, is to be added, it should be rubbed in a mortar with a little of the sand and thoroughly mixed with the main portion before the nutritive solutions are added. The amount of water (700 c.c.) thus added to 9 pounds of sand corresponds to about three fourths of its water-holding capacity, as 9 pounds are saturated by approximately 1 liter of water. In the pots with 17½ pounds of sand twice as much water can not be added for the diameter of the pots being the same in both cases the depth of the sand is twice as great. As stated above, the capacity of the sand for holding water diminishes with increase in the height of the column of sand. On this account only 900 c.c. of water can be added to the pots containing 17½ pounds of sand. If 1,000 c.c. are added the sand in the bottom of the pot becomes more wet than that at the top. In hot summer days, however, when the plants are growing rapidly and evaporation is at a maximum, 1,000 c.c. may be used.

If other materials—soil infusions, for example—are to be used they are best mixed with the nutritive solutions before the latter are added to the sand. After the solutions have been intimately mixed with the sand—best with a tin or German silver spoon—the sand is transferred to the pot.

Before the pots are filled provision must be made for circulation of air through the sand. The holes in the bottom of the pots are to facilitate this. The pot is filled to the depth of about one inch with pieces of quartz three fourths to one inch in diameter. These are covered with a layer of clean cotton batting. The pot is then filled to the top with the moist loose sand, which is only lightly packed. The implements used in the mixing and transfer of the sand are washed with a little distilled water, and in this way the residues of sand and nutritive solutions are brought into the pot. Of course all loss must be avoided and the pots must be filled to the right height. The pots used by the station vary so little in size that this makes little difficulty. The packing down of the sand in the pots is best done with a bent tin spoon an inch in diameter, the handle of which is lengthened by soldering on a heavy wire.

The subsequent watering of the plants is greatly simplified if the filled pots all have the same weight at the outset. The weights of the pots are readily equalized by varying the amount of quartz pebbles at the bottom. Since the same quantities of sand and water are added in each case these weights must be alike when filled. This weight remains unchanged, as at each watering enough water is added to bring it back to the original weight.

SEED AND PLANTING.

Only the best quality of seed is used. In order to insure the greatest possible uniformity among the grains of seed used in an experiment, a somewhat tedious but absolutely necessary process must be followed. From a large quantity of seed such grains are selected as are of unquestionably good quality, normally developed, in no way damaged, and as nearly as possible of the same size. The average weight of a single grain of the lot is then determined, and limits, varying with the weight of the seed in question, are selected within which the weights of the seeds to be used in the experiment shall fall. Then each grain is weighed with an accurate analytical balance, and only those are selected whose weights vary within the narrow limit. A few actual cases may be cited by way of explanation:

Weights of seeds used.

Kind of seed.	Average weight of seeds.	Range of weight allowed.
	Mg.	*Mg.*
Barley, 1894	33.8	31 to 36
Barley, 1885	36.4	32 to 38
Oats, 1883	43.7	41 to 47
Oats, 1884	39.9	35 to 43
Peas, 1883	172.2	164 to 180
Peas, 1884	181.2	170 to 190
Lupines, 1887	118.4	110 to 130

This accurate selection with the balance is indispensable in order to secure uniformity in the size of the seed and consequently equal amounts of reserve food for the use of the young plants. If this condition is observed, the size of the germinating plantlets in all the pots of a given series will be the same at the beginning of the experiment proper.

In case of very small seeds, such as clover, beets, etc., when weighing is not practicable, all the more pains should be taken in the selection.

The selected grains are soaked in distilled water for twenty-four hours and then allowed to germinate upon moist sand in a crystallizing dish. A sheet of filter paper is laid loosely over the seeds and the dish is covered with a glass plate. The seeds are planted as soon as the rootlets appear and a normal germ is visible, the latter being a necessary condition, especially in case of lupines. Only those grains should be used in a series of experiments which show as nearly as possible the same germinative energy. The germinated seeds are planted to the depth of 0.4 to 1 inch in the sand, and twice as many as the required number of plants are used.

When the seeds are planted a wadding is placed over the pots to keep the upper layer of sand from drying out, but removed as soon as the first plants appear.

CONDITIONS OF CULTURE OF THE PLANTS.

Almost every plant has its own special requirements as regards moisture and combinations of nutritive solutions. The following general rules will be found of use in the culture of plants whose requirements are not yet well worked out:

Small plants grow well in pots containing 9 pounds of sand, while larger ones, and especially those with longer roots, thrive better in pots 16 inches high and about 6 inches in diameter. Pots of the dimensions last named hold about 33 pounds of sand and can be handled with comparative ease. They are especially useful where it is desirable to grow a large number of plants in the same pot. If an increase in the volume of soil is required it is best to increase the diameter rather than the height of the pot.

The use of pots more than 16 inches, or at the outside 20 inches, in height for plants with deep-reaching roots has this disadvantage, that the water holding power of the sand decreases rapidly as its height is increased. Where deeper pots are necessary, as with sugar beets, some material must be added to the sand to increase its water-holding power, as will be explained beyond.

The degree of moisture best adapted to the wants of all plants seems to be 40 to 60 per cent of the total water-holding capacity of the soil.

Naturally there is no single combination of nutritive solutions which exactly meets the wants of all plants, but the following is perhaps as good a combination for general use as any:

4 c.c. of solution of K_2HPO_4.
4 c.c. of solution of $MgSO_4$.
4 c.c. of solution of KCl.
4 c.c. of solution of $CaCl_2$.
10 to 30 c.c. of solution of NH_4NO_3.

Phosphoric acid is here supplied as dibasic phosphate, the form best adapted to the needs of most plants. Some plants will bear a monobasic phosphate, but others will not endure it at all. Tribasic phosphates often do not produce good results.

As a rule the same amounts of solution will be sufficient for pots holding 17½ pounds of sand, but the quantity may be increased by half, *i. e.*, using 6 c. c. of solution instead of 4.

In general nitrogen is best applied in the form of ammonium nitrate, the quantity being regulated by the amount which the plants are capable of utilizing. If the use of other forms of nitric acid is desired, calcium nitrate is especially to be recommended and potassium nitrate next, or a mixture of both, but sodium nitrate does not seem to produce as good results.

The legumes thrive best when no nitrogen, or at least a very small quantity, is supplied, and always in the form of ammonium nitrate. Care must be taken, however, not only to have bacteria present in the soil, but also to have just the kinds needed by the particular kind of legumes. The sand, therefore, should be inoculated either with soil infusion or with a pure culture of the bacterium appropriate to the plant.

METHODS WITH SUGAR BEETS.

Sugar beets are grown in pots 32 inches deep. Pure sand can not be used for the experiments for the reason above stated, namely, that water can not be distributed evenly through so high a column of sand. The only way to surmount this difficulty is to increase the water-holding power of the sand. In efforts to accomplish this, various materials such as sawdust and so-called "alphastoff" were added, but entirely without success. The only admixture by the aid of which it has been found possible to produce normal beets is peat. The station uses Gifhorn peat* obtained from the newest layers.

Preparation of the peat.—To be fit for use the peat must be dry, finely pulverized and neutral in reaction, and unable to yield any considerable quantity of potash, phosphoric acid, or nitrogen to the plant. The crude peat must therefore be prepared for use. The process is as follows: The air-dried material is ground and passed through a 3 mm. sieve. Thirteen pounds of crude peat, equivalent to 11 pounds of dry

* Gifhorn is near Magdeburg.

matter, are then treated with 25 liters of 1 per cent hydrochloric acid. The mixture is thoroughly agitated and allowed to stand for three days. Recently 50 liters of the diluted acid have been used with 11 pounds of peat. After three portions of 13 pounds each have been extracted with dilute acid, they are placed in a large cask and washed with ordinary city (aqueduct) water until the acid reaction of the wash water completely disappears. The cask used is 4 feet high and 3 feet in diameter. It has a perforated shelf upon which the peat rests some distance above the bottom, and at the bottom is a stopcock by means of which the wash water is removed. The peat is treated with 230 liters of water for some hours, the water is drawn off and the treatment is repeated, with frequent stirring. Several such washings may be made in a day. The operation is repeated forty or fifty times so that 10 or 11 cm. of water will be used for the 33 pounds of dry substance treated. The peat is next divided into several small portions, which are washed with distilled water until upon testing no chlorine is found to be present. About 400 liters of distilled water are required for the final washing. The peat is then pressed and dried, precautions being taken to prevent its contamination by rain or dust.

This work is done in winter in the preparation room, and as the greenhouse is then empty it makes a very convenient drying room. By this extraction with hydrochloric acid the soluble plant food, particularly nitrogen, potash, and phosphoric acid, are almost completely removed. The acids (hydrochloric and humic) remaining in the peat are completely neutralized by the calcium carbonate contained in the aqueduct water, and the nitrogen, phosphoric acid, and potassium compounds left are in insoluble forms, or at least in such condition that the plants can only use extremely small amounts of them. Analysis of the dry matter of crude and purified peat gave the following results:

Analysis of crude and purified peat.

	Crude peat.	Purified peat.
	Per cent.	*Per cent.*
Sulphuric acid	0.730	0.149
Phosphoric acid	0.351	0.054
Calcium oxide	1.265	2.660
Magnesium oxide	0.239	0.389
Potassium oxide	0.086	0.017
Sodium oxide	0.585	0.140
Nitrogen	0.463	0.338

The increase of lime and magnesia in the purified peat comes from the water and results from the neutralization of the acids which the peat retains. The nitrogen content of the peat remains comparatively high after purification. Experiments have indicated, however, that the plants are able to utilize only that portion which is removed by the action of the hydrochloric acid. Thus the amount of dry substance of the sugar beet which a given quantity of nitrogen salts added to

the soil will produce can be approximately determined by experiment. Assuming that of the total nitrogen in the crude peat only that which can be removed by hydrochloric acid can be utilized, it is easy to calculate how much dry substance ought to be produced if the beet is grown in the crude peat. The observed results agree with the calculations, and the inference is that the beets utilize none, or at any rate extremely little, of the nitrogen of the purified peat.

The purified peat, after being passed again through a 3 mm. sieve and carefully mixed, is ready for use. Since peat will retain large quantities of water, it is necessary to add only about 6 per cent of it to the sand in order to produce an even distribution of the water throughout the beet pot.

Filling the pots.—The process of filling the pots may be described briefly (Fig. 18). It is not easy to mix dry sand and peat evenly, but this is readily done when 5 per cent of water is added to the sand. As a rule the material for a large number of pots, say thirty, is mixed at a single time. The necessary amount of sand is spread upon the carefully cleaned cement floor of the preparation room and the required quantity of water added. The sand is then mixed with shovels, passed through a 20 mm. sieve to break up any coarse lumps, spread out again, and the requisite amount of peat added. The whole mass is well mixed with shovels and passed through a 5 mm. sieve, thus securing a completely homogeneous mixture. It is then collected into a compact heap and covered for further use.

In filling the pots the portions, usually about 57 pounds each, are weighed out, and each portion is mixed with the nutritive solutions and necessary water in a large wooden trough and then placed loosely in the pot. The pots are of so nearly the same size that, with a little experience, it is an easy matter to fill them all to the same height.

Aeration and the distribution of water in the soil play an important role in these tall pots. In the earlier experiments a layer 2 inches deep of quartz pebbles about the size of dove's eggs was always placed upon the bottom of the pots, which had four openings. This layer was covered with cotton batting and the soil material then added. Later this arrangement was modified in several ways. The layer of stones was extended up the sides of the pot to a height of 8 inches on all sides, or the original arrangement was adhered to, but a perforated porcelain tube 10 inches high was placed upright in the center of the bottom, or an inverted porcelain funnel of about the same height was placed over the layer of pebbles to increase the air space within the pot. All these contrivances, however, had to be abandoned on account of the difficulty in regulating the moisture.

In the beginning the soil material contains about 14 or 15 per cent of water. The addition of any larger quantity than this would leave the excess to collect in the bottom of the pot while the plants are still small. The mass of beet roots soon reaches the bottom, however, and as soon as

the plants begin to grow rapidly the quantity of water may be increased to 17 or 18 per cent, according to the size of the beet. A great deal of difficulty is still met with, for, although the peat has the property of absorbing and retaining very large quantities of water, when it once does become dry it is very hard to moisten again, and unfortunately this happens very often both in the upper and lower parts of the pot. The sun dries out the surface soil, and the same result is produced at the bottom by the constant change of air and the avidity with which the beet roots absorb the water. Under certain conditions the moisture may sink as low as 2 per cent. With beets in normal growth only that portion of the soil lying between about 8 and 16 inches below the surface remains constantly moist. If a larger quantity of water is added to such a pot the upper and lower portions of the soil do not become thoroughly wet, and, since the middle portion can not retain the excess of water, it runs out through the holes in the bottom of the pot, carrying with it a portion of the plant food, and spoils the experiment. By careful and frequently repeated watering the upper portion of the soil may be brought back to the proper moisture content or even kept from drying out at all, but when the lower portion becomes dry this is impossible, and hence the plants can utilize only part of the food contained in this portion of the soil. These difficulties necessitated the following change in arrangement:

FIG. 18.—Cross section of pot, showing method of filling for sugar-beet cultures.

The holes in the bottom of the pot are tightly closed to prevent escape of water. An even layer of the quartz pebbles is placed on the bottom, and between this and the side of the pot is introduced a glass tube 34 inches long and 0.4 inch in inside diameter, reaching a few inches above the top of the pot. A flower pot 6 inches high and 8 inches wide at the top is inverted over the layer of pebbles. The space between the sides of the flower pot and culture pot is filled with quartz pebbles. The size of the pebbles gradually decreases from bottom to top until at the top the interstices become so small as to prevent the downward passage of the mixture of sand and peat. The pot is next filled about half full of the sand and peat, and then two glass tubes approximately 16 inches long are introduced on opposite sides of the pot and allowed to project a few inches above its top. Later on, a part of the water is added through these tubes, and is thus carried directly to the lower portions of the soil. The surface of the soil in the pot is covered to a depth of 4 inches with a layer of pure sand. It is easy to keep this sand constantly moist, and thus the upper por-

tion of the soil mixture of sand and peat below is prevented from drying out.

If care is taken to add water at proper intervals, partly at the top and partly through the short side tubes, the distribution of the water throughout the pot may be kept constant. The larger tube, which extends to the bottom of the pot, insures a sufficient supply of fresh air, and by the introduction of a smaller tube within it any water collecting in the bottom of the pot may be removed. Water seldom collects on the bottom of the pot, however, and probably this difficulty might be obviated entirely. The accompanying sketch (Fig. 18) shows the appearance of a beet pot filled in the manner just described. With an arrangement of this kind the water content of the soil may be increased without danger to more than 20 per cent when required by the growth of the beet.

CARE OF THE PLANTS DURING THE PERIOD OF VEGETATION.

As soon as the young plantlets have been placed in the culture pots they must be carefully shielded from injury, and especially from frost at night. If all grow, they must be thinned out while still young; that is to say, half, including the sickly ones, are removed. All of the plants thus taken out are analyzed to determine whether they have withdrawn any plant food from the soil medium, and, if so, how much.

Watering.—At this time the task of watering begins. As already explained, the moisture content of the soil must be watched closely, since it affects the growth so greatly and because, furthermore, the escape of water by transpiration serves as a measure of the growth of the plant. The maximum amount of water allowed for each pot corresponds to two thirds of the total water-holding capacity of the soil medium, be that pure sand or sand and peat. If no more water than this is added, none will run through the pot and no receptacle for water will be needed underneath. In regulating the water supply natural conditions of growth are imitated as closely as possible; that is to say, the soil is not kept evenly moist, but the quantity of water continually varies. The pots may be allowed to dry as much as can be done without injury to the plants, and then moisture is restored. In the watering of each pot the amount of water lost by evaporation is determined by weighing and is replaced by distilled water. A special arrangement for watering those pots which become hard to handle during the vegetation period has been contrived and completely meets the requirements of the case (Fig. 19). A workman places the smaller pots on the scales and returns them by hand, while the larger ones are moved by aid of a crane and pulleys. The watering itself is done by a station assistant. Two workmen can be used advantageously to insure a rapid and safe transfer of the pots. In this way it is possible to water a whole wagonful of the smaller pots in half or three quarters

of an hour. Four of these wagons are ordinarily used for small pots. The quantities of water evaporated are entered in a record book at each watering.

In watering the sugar-beet pots, of which there are about one hundred, weighing from 110 to 130 pounds each, the aid of two workmen is necessary. With them a wagonful of eleven pots may be watered in fifteen minutes. When, however, part of the water has to be added through the tubes above described the process is slower.

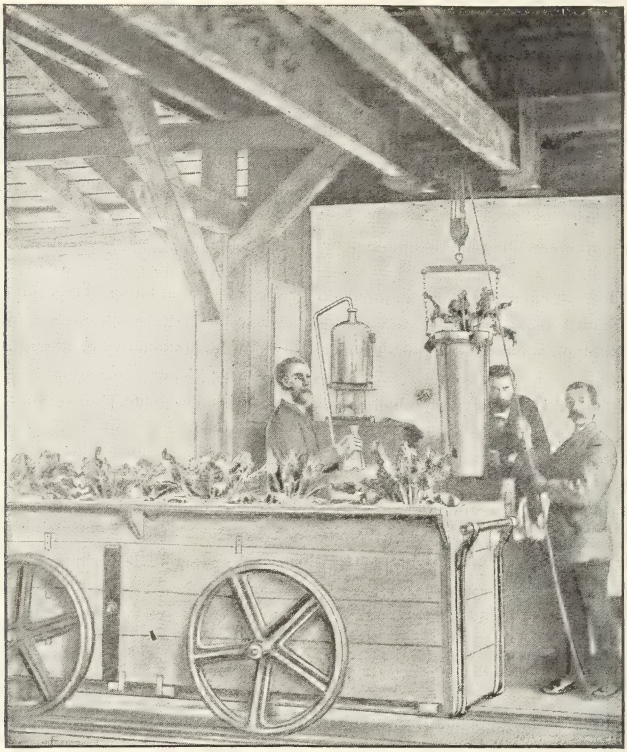

FIG. 19.—Method of watering large pots.

At the beginning of the experiment the plants are only watered at considerable intervals, but on hot summer days, especially in the period of rapid growth, they must be watered at least once and often twice a day. The majority of plants, such as the grains and also peas, lupines, etc., require during their period of maximum growth from 300 to 400 c.c. of water per day. Many plants need more; sugar beets, for instance, average a liter and a half. Under these conditions several hundred liters of water are used every day. This has to be prepared and carefully tested at the station.

The watering of the sterilized pots will be described beyond.

Support and protection of plants.—In order to protect from dam-

age by wind plants which grow to a considerable height, as peas, barley, oats, etc., supports are necessary. From two to four strips of wood, about 3 to $4\frac{1}{2}$ feet long, are fastened perpendicularly by wire to the outside of the pot, at equal distances from each other. Between them, at intervals of about 8 inches, are placed rings of glass tubing with three or four radial connections. For the grasses a single glass tube is usually placed in the middle of the pot, held in place at the top of the pot by a glass rod crossing the pot at right angles and fastened to its edges. The rings are then placed at intervals upon this upright rod. The individual parts are made to grow through the several open divisions of the rings, *i. e.*, are separated by the radial rods, and these supports generally suffice, although fastening with twine is sometimes necessary. The upright rods, rings, etc., are weighed and their weight added to that of the pot.

The ways in which the plants are protected from possible harm from birds and from bad weather, without interference with the supply of light, were described above. The plants must be carefully and persistently kept free from worms and insects, which often make their appearance in large numbers. All leaves which fall off during the period of vegetation are collected, dried, and added to the crop at the close of the experiment.

Records of observations—photographs.—Notes on the condition of the plants are made at short intervals during the summer, and thus a record of their growth is obtained. All plants which show any interesting peculiarities are photographed. This is done especially with series of plants to which have been added different amounts of a given plant food. Such series are photographed several times; for example, when the action of the plant food begins to be manifest, when the plants are in blossom, and when they are mature. The roots of the plants are photographed in water in a holder devised for the purpose. This holder is a water-tight box 24 inches long, 2 inches wide, and 12 inches deep. The sides are of glass and the ends of tin. The top is open, and when in use the box is filled to the brim with water. The roots are spread out in any shape desired within the box, and thus photographed.

HARVESTING THE PLANTS.

In harvesting, the parts of the plants above and beneath the soil must be collected and sometimes also the soil material itself. The correct answers to all the questions which have been raised in the experiments above described are to be found by analyzing, not the whole plants together, but the various parts, stem and leaves, seed, chaff, and roots, separately. In this way alone is it possible to find out through chemical analysis which of the different nutritive materials are of special use in building up this or that part of the plant; in what form the plant food may be supplied with the greatest advantage, and, if the

plants are harvested in different stages of development, at what period of growth the plant takes up the main part of its food.

We may first describe the harvesting of the parts of the plant above ground. All plants are cut off just above the root. In case of the *Gramineæ* the stalks with and without ears are counted and measured. The ears are then cut off from the stalks, and measured after the removal of the chaff. The grains of each ear, both normal and undeveloped, are counted and separated.

The straw is cut into short pieces and the several parts of the plant, namely, straw, chaff, and normal and undeveloped grains of seeds, are placed in paper bags. The paper used in making these bags will stand a temperature of 100° to 105° C. for several days without breaking.

The procedure is the same with peas, lupines, mustards, etc. The main stem and the branches are measured, the seeds, both normal and undeveloped, are separated and collected as above described.

The parts of the plant which have been harvested are dried to a constant weight in ovens, which are heated to 100° C. by gas at a constant pressure, and then carefully weighed. Immediately after weighing each part is ground as quickly as possible in a warm iron mortar and passed through a 1 mm. sieve. The pulverized material is placed in tightly stoppered bottles to prevent the further absorption of moisture and is kept in this way for subsequent chemical analysis. Of course the data thus obtained and all points of interest regarding the plants are entered in the proper record books.

In collecting the subterranean parts of the plants one or the other of the two following methods is employed, according as the roots only, or both roots and soil, are to be analyzed: If the roots only are to be harvested the pot is inverted upon a 0.5 mm. sieve about 50 cm. in diameter. By gently tapping the pot the soil separates from its walls and the pot may then be easily removed, leaving the contents in its almost unaltered form standing upon the sieve. The quartz pebbles and sheet of cotton originally in the bottom of the pot, but now upon the top of the soil, are removed with great care so as not to disturb the roots, and the sieve with its contents is then immersed in a cask of water. With gentle shaking the sand passes through the sieve while the roots remain upon it. By careful shaking or washing with a small stream of water the separation of the sand from the roots may be almost complete.

The roots are then placed in an evaporating dish, which is best lined with filter paper to prevent the roots from sticking to its surface, and are dried at ordinary or low temperature. After drying, the roots are cut into short pieces and placed again upon a 0.5 mm. sieve in order to separate the sand still adhering to them. The subsequent drying at 100° C., weighing, grinding, and preservation are performed in the usual way.

If the sand is to be collected for analysis at the same time as the

roots, the pot is first placed upon a 2 mm. sieve. After the pebbles and cotton have been removed the mass is broken up somewhat and half or two thirds of the sand passed through the sieve, with care to avoid rubbing, which would injure the roots. The roots and the adhering sand are then transferred to a 0.5 mm. sieve and treated as described above.

The sand obtained by the first sifting is dried at ordinary temperature in large open dishes and then passed through a 0.5 mm. sieve. The roots remaining upon the sieve are then added to larger portion, and the sand is preserved in stoppered glass bottles. In the case of pots which have been kept sterilized the layers of coarse sand and peat must be carefully removed from the surface of the sand before the process of separation of sand and roots is begun.

The harvesting of the sugar beets is conducted in a somewhat different manner. As soon as the beets have been removed from the pot the leaves and small roots are cut off and all adhering soil material is carefully brushed and washed away. The beets are photographed, generally several together, especially when a series of experiments has been conducted to show the effects of different quantities of a given plant food. Thereupon the beets are taken at once to the laboratory, where, as a rule, the following determinations are made, namely, weights of fresh and dry substance of the beet, leaves, and roots; the sugar content, determined by the polarization of the juice and by digestion with alcohol; and the content of nitrogen, phosphoric acid, and potash, as the case may demand. Complete ash analyses also are often made. These several operations are conducted as follows: As soon as the beets come to the laboratory the stems are cut off and weighed. Two hundred grams are then cut from each beet. This portion is first pulverized in a mortar, and the requisite amount weighed out for extraction with alcohol. The juice is completely pressed from the remainder by a hydraulic press capable of 300 atmospheres pressure, and polarized. In both alcohol extract and expressed juice the sugar is determined with Fehling's solution. The rest of the beet, the parts, of course, being so selected as to represent the average composition of the whole, is cut into disks 2 mm. in thickness, and weighed. These disks are strung upon cords and dried at a temperature of 30° to 40° C. in the large drying oven in the laboratory, mentioned above.

In this way 90 to 95 per cent of the water can be removed from the beets. The disks are then broken into small pieces and these are dried for some time in small ovens at 60° to 70° C. They are then weighed and immediately pulverized and preserved; this is used for the determination of the actual dry matter by final drying in hydrogen, and for all analyses. When the preliminary drying is carefully made no decomposition occurs and the finely pulverized beet will be almost completely white.

Collecting the beet roots which remain behind in the pots is a much

more difficult process than in case of the small culture pots, inasmuch as the soil consists of a mixture of sand and peat. All the soil is passed through a 3 mm. sieve, which retains the roots with a large quantity of adhering peat, the loss of roots being only slight. The mixture of roots and peat is then placed upon a 0.5 mm. sieve and a slightly smaller 3 mm. sieve is fitted into this bottom upward so as to make the equivalent of a sieve with two meshes, one at the bottom and one at the top. The sieves are then immersed in water and moved repeatedly up and down. During the process the sand sinks through the 0.5 mm. sieve below and the peat floats out through the 3 mm. one, while the long roots are left between the two. In this manner the peat may be almost completely separated from the roots. The roots are collected and treated in the ordinary way.

EXAMPLES OF SAND CULTURE EXPERIMENTS.

The success which the Bernburg Station has met with in securing normal development of plants in sand cultures, and the nutritive solutions used, are illustrated by the following examples from the records of some recent experiments.

Sugar beets.—Following is the composition of the nutritive solutions used in 1889, 1890, and 1891:

Composition of nutritive solutions.

1889.	1890.	1891.
Grams.	*Grams.*	*Grams.*
5,220 K_2HPO_4.	4,350 K_2HPO_4.	6,960 K_2HPO_4.
2,235 KCl.	1,200 $MgSO_4$.	4,470 KCl.
1,800 $MgSO_4$.	14,350 $Ca(NO_3)_2$.	1,800 $MgSO_4$.
24,600 $Ca(NO_3)_2$.	12,625 KNO_3.	16,400 $Ca(NO_3)_2$.
	15,000 $CaCO_3$.	10,100 KNO_3.

The yields of dry matter were as follows:

Yields of dry matter.

	1889.	1890.	1891.
	Grams.	*Grams.*	*Grams.*
Beet	116.9	117.6	114.5
Foliage	49.4	50.2	51.3
Total	166.3	167.8	165.8
Weight of fresh beet	525.7	552.5	604.6

Three hundred milligram equivalents (equal to 4.2 grams of nitrogen) were supplied in the solutions each year. If the quantity of nitrogen is diminished there is naturally a decrease in the yield, and when nitrogen is entirely wanting there is scarcely any growth at all, even in presence of all the other elements of plant food.

Barley.—Three experiments, numbered here 1, 2, and 3; pots 10 inches in height and 6 inches in diameter; sand, 9 pounds per pot. Moisture of soil during vegetation varied from 10 to 15 per cent of the whole weight of the soil, or from 40 to 60 per cent of the water-holding capacity of the sand. Fourteen grains of seed planted, seven plants allowed to grow.

Experiment No. 1.

Nutritive solution per pot .. $\begin{cases} 0.5444 \text{ grm. } KH_2PO_4 = 4 \text{ c. c. solution.} \\ 0.1492 \text{ grm. } KCl = 2 \text{ c. c. solution.} \\ 0.2400 \text{ grm. } MgSO_4 = 4 \text{ c. c. solution.} \\ 1.9680 \text{ grm. } Ca(NO_3)_2 = 24 \text{ c. c. solution.} \end{cases}$

Four grams of calcium carbonate were added also.

Yield of dry matter 29.343 grams, of which 10.83 grams was grain.

Experiment No. 2.

Nutritive solution per pot.. $\begin{cases} 2 \text{ c. c. solution of } K_2HPO_4 = \begin{cases} 4\times 39 \text{ mg. K.} \\ 2\times 71 \text{ mg. } P_2O_5. \end{cases} \\ 4 \text{ c. c. solution of } MgSO_4 = \begin{cases} 4\times 12 \text{ mg. Mg.} \\ 4\times 16 \text{ mg. S.} \end{cases} \\ 2 \text{ c. c. solution of } KNO_3 = \begin{cases} 2\times 14 \text{ mg. N.} \\ 2\times 39 \text{ mg. K.} \end{cases} \\ 14 \text{ c. c. solution of } Ca(NO_3)_2 = \begin{cases} 14\times 20 \text{ mg. Ca.} \\ 14\times 14 \text{ mg. N.} \end{cases} \end{cases}$

Yield of dry matter 22.82 grams, of which 7.70 grams was grain. In this case so little phosphoric acid and nitrogen was supplied that neither produced its full effect.

Experiment No. 3.

Nutritive solution per pot.. $\begin{cases} 4 \text{ c. c. solution of } KH_2PO_4. \\ 3 \text{ c. c. solution of } MgSO_4. \\ 2 \text{ c. c. solution of } KCl. \\ 40 \text{ c. c. solution of } Ca(NO_3)_2. \end{cases}$

The quantity of nitrogen solution in this case was so large that it could not all be added at one time. It was therefore given in three portions as follows, and thus injury to the young plants by a large excess was avoided: 20 c. c. of $Ca(NO_3)_2$ solution at time of filling the pots, April 27, 10 c. c. on May 12, 10 c. c. on May 26. The other solutions were added all at one time, as usual, when the pots were filled.

Yield of dry matter 46.45 grams, of which 18.42 grams was grain. This yield is exceptionally large; indeed, it is probably the maximum which can be produced in the use of so small a volume of soil, namely, 4 kg. of sand. It should be stated that the season was an especially favorable one, as the temperature during the last of May and June was comparatively low. This allowed the plants to develop slowly and thus to utilize the nitrogen to the best advantage. If the temperature is high at the time of the most active growth of the *Gramineæ*, they shoot up very fast, and if at the same time nitrogen is present in large quantities it not only can not be assimilated but may even be injurious.

Oats.—Three experiments, numbered here 1, 2, and 3, culture pots, 10 inches high and 6 inches in diameter; sand, 9 pounds per pot; moisture, from 10 to 15 per cent; fourteen seeds planted, seven plants allowed to grow.

Experiment No. 1.

Nutritive solution per pot .. { 4 c. c. solution containing 0.5444 grm. KH_2PO_4
2 c. c. solution containing 0.1492 grm. KCl.
4 c. c. solution containing 0.2400 grm. $MgSO_4$.
24 c. c. solution containing 1.9680 grm. $Ca(NO_3)_2$ and in addition 4 grm. calcium carbonate.

Yield of dry matter 30.175 grams, of which 12.234 grams was grain.

Experiment No. 2.

Nutritive solution per pot .. {
4 c. c. solution of $K_2HPO_4 = \begin{cases} 8 \times 39 \text{ mg. K.} \\ 4 \times 71 \text{ mg. P.} \end{cases}$
4 c. c. solution of $MgSO_4 = 4 \times 12$ mg. Mg.
4 c. c. solution of $CaCl_2 = \begin{cases} 4 \times 20 \text{ mg. Ca.} \\ 4 \times 35.5 \text{ mg. Cl.} \end{cases}$
16 c. c. solution of $Ca(NO_3)_2 = 16 \times 14$ mg. N.

The calcium carbonate was left out, as it seemed to produce injurious rather than beneficial results. The phosphoric acid was not supplied in form of the monobasic salt, as in the first example, but as a dibasic phosphate. This form seems to be fully as well if not better adapted to oats and barley than the other.

Yield of dry matter 23.013 grams, of which 8.080 grams was grain.

Experiment No. 3.

Nutritive solution per pot.... {
4 c. c. solution of KH_2PO_4.
3 c. c. solution of $MgSO_4$.
2 c. c. solution of KCl.
40 c. c. solution of $Ca(NO_3)_2$.

It should also be mentioned that the nitrogen was added in three portions of the same relative size as in case of the barley.

Yield of dry matter 40.83 grams, of which 16.53 grams was grain. The conditions (weather, etc.) were the same as those of the barley experiment No. 3.

[An account of the methods followed at the Bernburg station in the study of the assimilation of free atmospheric nitrogen by plants will be given in the next number of the Record.]

ABSTRACTS OF PUBLICATIONS OF THE AGRICULTURAL EXPERIMENT STATIONS IN THE UNITED STATES.

CHEMISTRY.

E. W. Allen, *Editor.*

Saponifying butter fat by the Leffmann and Beam method, C. L. Penny (*Delaware Sta. Report for 1892, pp. 126, 127*).—A number of comparisons were made between the Leffmann and Beam and the Reichert-Meissl-Wollny methods for estimating the volatile fatty acids in butter, using both glass and tin condensers.

It must be concluded from these results that there is no appreciable difference between the several methods on samples of fresh butter. Rancid butter, it is true, seems to lose some volatile acids by the glycerin-soda method during the heating in an open flask, and gives lower results accordingly. Certainly metallic tin has no effect on the distillate, nor has the fact of the previous melting or not melting of the free fatty acids. Even in the case of rancid samples of butter the Leffmann-Beam method must be regarded as fully as reliable for distinguishing genuine butter fat; it is only where the question of comparing results with those by the older method arises that there need be hesitation in using the new method. The remarkable saving in time afforded by the Leffmann-Beam method makes it one of the most valuable acquisitions to the food chemist. It will be found as useful as it is ingenious.

Report of chemical division of Rhode Island Station, H. J. Wheeler (*Rhode Island Sta. Report for 1892, pp. 199-208*).—Brief accounts are given of the workings of the fertilizer control, examination of seeds, contribution to the experiment station exhibit at the World's Fair, and miscellaneous work, together with analyses of swamp muck, wood ashes, a fertilizer prepared from garbage and city refuse, a mixed fertilizer, milk, and water.

METEOROLOGY.

W. H. Beal, *Editor.*

Meteorological observations at Delaware Station, W. H. Bishop (*Delaware Sta. Report for 1892, pp. 128-142*).—Monthly summaries of observations at six stations in the State on temperature, pressure, and

rainfall are given. A summary for the year will be found in the following table:

Annual summary of meteorological observations.

	Newark.	Middletown.	Dover.
Temperature (degrees F.):			
Highest	99 (July 26)	100 (July 26)	104 (July 26)
Lowest	2 (Jan. 17)	12 (Jan. 21	8 (Jan. 21)
Mean	51.50	52	53.28
Rainfall (inches):			
Total	39.19	46.21	44.32
Number of days on which 0.01 inch or more of rain fell	102	93	87
Pressure (inches):			
Highest	30.71 (Feb. 17)	....	....
Lowest	29.24 (Jan. 6)	....	....
Mean	30.06	....	....

	Milford.	Seaford.	Millsboro.
Temperature (degrees F.):			
Highest	97 (July 26)	100.7 (July 26)	100.5 (July 26)
Lowest	10 (Jan. 21)	8 (Jan. 20)	6 (Jan. 21)
Mean	54.56	53.81	53.53
Rainfall (inches):			
Total	39.87	39.59	44.89
Number of days on which 0.01 inch or more of rain fell	88	90	114
Pressure (inches):			
Highest	....	30.75 (Feb. 17)	....
Lowest	....	29.27 (Jan. 6)	....
Mean	....	30.08	....

The weather conditions for the year were, as a rule, normal, the most noticeable feature being the hot weather of the week beginning July 24, during which time a temperature of 100° F. was reported from several stations, and the mean temperature ranged from 82.3° to 85° F.

Meteorological observations at Rhode Island Station, L. F. Kinney (*Rhode Island Sta. Report for 1892, pp. 249–251*).—Tabulated summaries are given of observations on temperature, pressure, movement of wind, precipitation, and cloudiness for each month of 1890, 1891, and 1892.

FERTILIZERS.

W. H. Beal, *Editor.*

Green manuring, A. T. Neale (*Delaware Sta. Report for 1892, pp. 19–22*).—The principles of green manuring are briefly stated, the value of crimson clover and cowpeas for this purpose is discussed, and the results of experiments with crimson clover as compared with nitrate of soda on corn, and with pea vines as compared with timothy sod turned under for rye, or left on the ground as a winter mulch for corn land, are reported.

On one of two adjoining plats a crop of crimson clover, estimated at 8 tons 600 pounds per acre, was turned under during the first week of June, 1892, and the land immediately planted with corn. On the other,

corn was planted June 7, and top-dressed with 100 pounds of nitrate of soda per acre.

Eight tons 600 pounds of crimson clover from seed, which costs $1 per acre, added 24 bushels to the corn crop. One dollar invested in nitrate of soda and used as a top-dressing added 6 bushels to the corn crop. Hence, in this case $1 invested in clover seed returned four times as much as $1 invested in nitrate of soda. As to the relative amount of labor involved, the sowing of the seed and the broadcasting of the nitrate possibly balance each other. Plowing down a green crop is doubtless far more costly than plowing bare ground. This drawback may reduce the above-named apparent gain by approximately 25 per cent.

Rye was grown on two fourth-acre plats, on one of which a heavy growth of cowpea vines was turned under, and on the other a thin sod of timothy, with the following results: "Four acres dressed with pea vines yielded 93 bushels of rye; 4 acres of timothy sod yielded 18 bushels of rye. * * * Unless, therefore, conditions quite unknown and unsuspected at this time influenced the results, green manuring with pea vines increased this rye crop more than fivefold."

From a variety of causes, which are noted, the experiments carried out on two farms with pea vines as a winter mulch for corn land failed to give exact results, but that benefit was derived from the practice is clearly indicated.

Fertilizer inspection and analysis in Connecticut (*Connecticut State Sta. Report for 1893, part I, pp. 1-64*).—Attention is called to the principal requirements of the State fertilizer law as amended by the general assembly at its session in 1893, and the full text of the law is given, together with a list of manufacturers complying with the law in 1893; explanations relating to the analysis of fertilizers and the valuation of their active ingredients; trade values of fertilizing ingredients in crude stock for 1893; the composition and valuation of the various raw materials furnishing nitrogen, phosphoric acid, and potash; and tabulated analyses of 60 samples of fertilizing materials including home-mixed and manufactured fertilizers, nitrate of soda, sulphate of ammonia, cotton-seed meal, castor pomace, fish, horn dust, tankage, bone, dissolved boneblack, dissolved bone, sulphate of potash, sulphate of potash and magnesia, muriate of potash, ashes, cotton-hull ashes, blood albumin, waste peaches, peat moss, swamp muck, saltpeter waste, and buttermilk curd.

The average cost of bone manures was $31.70, and the average valuation $32.01 per ton. The close agreement of cost and valuation in the case of bone indicates that the station's schedule of valuation is in substantial agreement with the actual market prices. There has been no cheaper form of readily available organic nitrogen in the market the past year than fine ground bone and tankage. * * *

Of the 49 brands [of nitrogenous superphosphates] here reported 17 are below their minimum guaranty in respect of one ingredient, and 3 in respect of two ingredients. That is, considerably more than one third of all the nitrogenous superphosphates in our market contain less of one or of two ingredients than they are claimed to contain. * * * The average cost of the nitrogenous superphosphates is $32.99, the average valuation $23.48, and the difference 40.5 per cent. * * *

Of the 50 brands of special manures analyzed, 13 are quite below the manufacturer's minimum guaranty in respect of one ingredient, and 9 are below in respect of two ingredients. * * * The average cost per ton of the special manures has been \$37.76, the average valuation \$29.35, and the difference 28.6 per cent. Last year the corresponding figures were, average cost \$38.28, average valuation \$30.70, difference 25 per cent. * * *

The cost of potash per pound at retail in cotton-hull ashes has ranged from 4.9 to 11.4 cents per pound and has averaged 6.9 cents. Cotton-hull ash has ceased to be a cheap source of potash. On the average, potash has cost this year over a cent per pound more in this form than in high grade sulphate.

Coöperative experiments with fertilizers, A. T. NEALE (*Delaware Sta. Report for 1892, p. 22*).—*Tests of local significance* (*p. 22*).—Coöperative experiments on four farms with fertilizers on peach trees, cowpeas, and wheat are briefly referred to.

Coöperative field experiments with fertilizers on corn, J. D. TOWAR (*Rhode Island Station Report for 1892, pp. 163–198*).—Experiments on the same plan as those described in the Annual Report of the station for 1891 (E. S. R., vol. IV, p. 246) were carried out during 1892 on six farms in the State including that of the station. The kind of fertilizers remained the same, but the amounts were varied in accordance with the experience of the two previous years. On the three plats which heretofore had received 150 pounds of nitrate of soda, alone or combined with 350 pounds of dissolved boneblack, or 130 pounds of muriate of potash per acre, the amounts of these substances were increased to 480, 600, and 200 pounds, respectively. As usual the results are tabulated in full and summarized for each experiment.

To give a thorough review of the results would be simply to reiterate all that was given in the report of one year ago with perhaps a few more conclusions that this year's experiment has brought to view, as follows:

(1) The past year's experiment has given us no occasion to wish the withdrawal of a single statement made in the two former reports.

(2) Phosphoric acid has in every case proven itself the most deficient, followed by nitrogen.

(3) In the special nitrogen tests, nitrate of soda takes first place in five cases and sulphate of ammonia in one. Nitrate of soda takes second place in one case, dried blood in three, and sulphate of ammonia in two,

(4) The ill effects of sulphate of ammonia were wholly prevented by the application of lime.

FIELD CROPS.

J. F. DUGGAR, *Editor.*

Field experiments with hay crops, oats, corn, muskmelons, soja beans, and cowpeas, C. O. FLAGG and J. D. TOWAR (*Rhode Island Sta. Report for 1892, pp. 129–162*).

Synopsis.—The experiments reported were in the following lines: (1) A comparison of winter and spring application of ashes to newly seeded meadows; (2) variety test and fertilizer experiments with oats, test of broadcasting *vs.* drilling, and experiments with the Jensen hot-water treatment for smut of oats; (3) variety test of muskmelons; (4) test of shrinkage of corn and fertilizer experiments with corn; and (5) variety tests of soja beans and cowpeas and a fertilizer experiment with cowpeas.

Winter and spring application of ashes to newly seeded meadows (pp. 129, 130).—Canada unleached ashes at the rate of 2½ tons per acre were applied broadcast to one plat in September, 1890, and to another plat in January, 1891. In 1892 the crop of hay on the plat fertilized in the fall was 1,060 pounds per acre; on the plat fertilized in the spring, 1,040 pounds.

Experiments with oats (pp. 131–138).—Brief notes, with a statement of yield, are given for 10 varieties of oats.

No smut appeared on oats treated by the Jensen method, and but little on the untreated plats. When the temperature of the water used was above 137.5° F. the vitality of the grain was injured.

The crop of oats grown in 1892 on plats fertilized in 1890, either with Horse-foot guano or mixed chemicals, and in 1891 with seaweed, showed no marked residual effect from these fertilizers. Lime at the rate of 1,776 pounds per acre gave 91 pounds of grain per acre in excess of the yield of the unfertilized plat. Broadcasting gave 2.2 per cent more grain and 12 per cent more straw than did drilling.

Muskmelons (pp. 143, 144).—Brief notes on 16 varieties are given.

Experiments with corn (pp. 130, 131, 138–142, 144–149).—Fifty ears of White Capped and the same quantity of Lackawaxen corn, husked November 5, 1891, were hung in a corn crib until April 15, 1892. The White Capped lost 15.5 per cent in weight, the Lackawaxen 24 per cent.

The yields of corn on each of 48 permanent plats are tabulated. The results secured by applying equal values of dissolved South Carolina rock, dissolved boneblack, double superphosphate, floats, and slag are tabulated.

Another field which had been heavily fertilized with stable manure in 1891 was used to test the effect of lime and three forms of phosphate, alone and in combination. The application of 1,400 pounds of lime per acre gave a gain of only 23 cents per acre in the total value of the crop.

In another experiment including 20 plats, 16 received lime alone at the rate of 320 pounds per acre, double superphosphate alone at the rate of 320 pounds, or both together; the application of fertilizers was unprofitable except on one plat.

Soja beans and cowpeas (pp. 149–162).—A popular discussion of these two plants with tabulated data, giving the yield of 3 varieties of each and the yield of cowpeas fertilized with dissolved South Carolina rock, dissolved boneblack, double superphosphate, muriate of potash, and nitrate of soda, alone or in combination. In the variety tests the yields were as follows: Black cowpea yielded 5,856 pounds of dry matter per acre containing 157.5 pounds of nitrogen; Blue cowpea 4,153.5 pounds of dry matter, containing 91.3 pounds of nitrogen; Unknown cowpea, 4,960 pounds of dry matter containing 145.8 pounds of nitrogen; three Japanese beans varied in yield of dry matter from 3,232 to 5,754 pounds per acre, containing from 81.9 to 132.4 pounds of nitrogen. In the fertilizer test the largest yield of green cowpea vines, 7,000 pounds per

acre, was made when nitrate of soda entered into the ration. Nitrate of soda alone gave vines affording the maximum amount of nitrogen, 30 pounds per acre. On the unfertilized plat the vines contained 24.4 pounds of nitrogen per acre, the roots 4.3 pounds per acre.

Field tests of cowpeas and soja beans, A. T. NEALE (*Delaware Sta. Report for 1892, pp. 31-35*).—At Dover the Conch pea yielded 12.9 tons of green forage per acre, Unknown 12.8, Clay 8.7, Stewart 8, Black 3.1, and soja beans 8.6. The Black was at a disadvantage in that all the leaves had fallen and the pods were dry when it was harvested, while the plants of the other varieties were fresh and green and the leaves still in place. The Black pea yielded 19.8 bushels of seed per acre. It was found that with three seeds in a hill, rows 32 inches apart, and hills 17½ inches apart, a bushel of Conch seed would plant 6.5 acres, a bushel of Unknown 4.5 acres, of Clay 5 acres, of Stewart 5 acres, of Black 3 acres, and of soja beans 4 acres.

Brief descriptive notes on soja beans and the above varieties of cowpeas are given. A fertilizer test was conducted with each of the above varieties of cowpeas and with soja beans, using 160 pounds of nitrate of soda per acre, 160 pounds of muriate of potash, and 400 pounds of superphosphate, either alone or in combination. The greatest net profit in every instance resulted from the use of muriate of potash alone, the increased crop due to nitrate of soda being in no case sufficient to meet the increased cost of that fertilizer. Brief statements give the results of fertilizer tests made by several farmers in the State.

A summary of four years' experimenting on the same plat, A. T. NEALE (*Delaware Sta. Report for 1892, pp. 23, 24*).—This is a record of four years' experiments with fertilizers on corn, sweet potatoes, cowpeas, and wheat in rotation. "Each crop in this rotation was offered every possible combination of nitrogen, phosphoric acid, and potash." Corn yielded most abundantly with nitrate of soda and muriate of potash; the sweet potatoes and cowpeas yielded best on a crimson clover sod, dressed with muriate of potash and acid phosphate; and the wheat gave the best return with nitrate of soda and acid phosphate. It is estimated that the net gain per acre due to these fertilizers was for corn $9, sweet potatoes $62.50, cowpeas $13.27, and wheat $10.43.

Muriate of potash on Indian corn, A. T. NEALE (*Delaware Sta. Report for 1892, pp. 24–27*).—An account is given of an experiment on 42 plats (166 feet by 15 feet 4 inches) with nitrate of soda, muriate of potash, and acid phosphate alone or combined, and with gypsum and lime. The experiment was in continuation of one described in the Annual Report of the station for 1891 (E. S. R., vol. v, p. 575). The objects were "to determine which ingredient of commercial fertilizers

exercised most favorable action on corn; next to learn how that element should be applied; and finally to note the effects which might be caused upon grain yields by the removal of corn tassels from every stalk on every other row."

On one third of the plats the fertilizers were harrowed in before the corn was dropped; on another they were applied as a top-dressing when the plants were from 8 to 12 inches tall; and on the remainder one half was applied before the seed was planted and the other as a top-dressing after the plants were at least 8 inches tall. The season was so unfavorable that, as the records show, the yield with a complete fertilizer in 1892 was less by 700 pounds per acre than that on unfertilized plats in 1891.

Under these extremely unfavorable conditions muriate of potash, alone and in every combination with nitrogen and phosphoric acid, gave a good average crop when it was used either in part or wholly as a top-dressing.

Every other row of corn on each of the three sections of plats designated above was detasseled as soon as the tassels appeared, and the effect on the yield noted. The percentage of increase favoring detasseling was as follows: Section 1, 54; section 2, 32.5; and section 3, 1.5 bushels.

The following practical deductions are drawn from the experiment as a whole:

Use muriate of potash on your corn, 160 pounds per acre, one half harrowed in at the time of seeding and the other half as a top-dressing when the crop is 8 inches tall. Just as soon as you can find the tassels, remove them from all stalks on every other row of corn. Your crop will not be damaged thereby and your profits may be very much increased.

Sugar corn fodder, A. T. NEALE (*Delaware Sta. Report for 1892, pp. 35–38*).—A 25-acre field of sweet corn yielded 138,698 pounds of ears, worth at the cannery $658.82, or an average of $26.34 per acre. The yield of fodder was at the rate of 5,676 pounds per acre, containing 1,390 pounds of dry matter. A comparison is made between the food ingredients in grain and fodder of an acre of field corn and one of sweet corn. On the basis of a yield of 60 bushels of shelled corn per acre, "the field corn produced twice as much protein, two and a half times as much carbohydrates and fiber, and four times as much fat per acre as the sweet corn."

Crimson clover and Italian rye grass, A. T. NEALE (*Delaware Sta. Report for 1892, pp. 38, 39*).—Experiments in sowing these two forage plants together are in progress.

Crimson clover, A. T. NEALE (*Delaware Sta. Report for 1892, pp. 8–19*).—A reprint of Bulletin No. 16 of the station (E. S. R., vol. IV, p. 139).

Spurry, R. C. KEDZIE (*Michigan Sta. Bul. No. 101, Dec., 1893, pp. 13–15*).—Spurry is highly commended for the Jack-pine district. Analysis of spurry plants with mature seed gave the following results:

	Per cent.
Moisture	5.39
Ash	9.62
Crude fat	5.76
Crude protein	13.56
Crude fiber	57.10
Nitrogen-free extract	8.57
	100.00

The crude protein consisted of 10.19 per cent of albuminoids and 3.37 per cent of amides.

"The report comes from Newaygo and vicinity that spurry [there] has proved a great disappointment."

Flat pea (Lathyrus sylvestris), R. C. KEDZIE (*Michigan Sta. Bul. No. 101, Dec., 1893, pp. 15, 16*).—On the station grounds two-year old plants made a good growth, measuring 3 feet on July 13. A square rod cut July 12 yielded at the rate of 16 tons of green forage per acre, equal to 4 tons of hay. An analysis of *Lathyrus sylvestris* gave the following results:

	Per cent.
Moisture	7.99
Ash	8.32
Crude fat	2.08
Crude protein	27.17
Crude fiber	26.70
Nitrogen-free extract	27.74
	100.00

"Of the crude protein the albuminoids constitute 14.36 per cent, while the amide compounds form 12.81 per cent."

Peppermint hay, R. C. KEDZIE (*Michigan Sta. Bul. No. 101, Dec., 1893, pp. 16, 17*).—After the oil is distilled from peppermint the residue, known as mint hay, is used for feeding to stock. An analysis of mint hay gave the following result:

	Per cent.
Moisture	11.40
Ash	6.04
Crude fat	1.80
Crude protein	9.56
Crude fiber	35.47
Nitrogen-free extract	36.73
	100.00

Composition of the grain and straw of wheat at different periods of ripening, R. C. KEDZIE (*Michigan Sta. Bul. No. 101, Dec., 1893, pp. 2–12, diagrams 3*).—For this experiment Clawson wheat was

used. Cuttings were made daily from June 14 to July 29, 1892. When the work began the plants had headed out and were in blossom, but the berry was still very immature. Tabulated data and diagrams give the number of kernels in 10 grams of grain, and the percentage of ash, crude fat, crude fiber, nitrogen-free extract, albuminoids and amides in the grain and in the straw at different dates. Notes on the appearance of the plants when each cutting was made and a summary of the meteorological conditions for each day of the test are given. At the twenty-second date of cutting, when the wheat was in the dough, the straw compared favorably in nutritive value with that from the earlier cuttings. "If the crop is harvested as soon as the grain is fully mature there is little loss of feeding value in the straw. While the grain gains nothing by dead ripening, the straw rapidly loses value by overripening."

No further conclusions are drawn from the elaborate tabulated data. One of the diagrams shows the results of a similar investigation carried on by the chemical department of the Michigan Agricultural College in 1879.

HORTICULTURE.

Electroculture, C. D. WARNER (*Massachusetts Hatch. Sta. Bul. No. 23, Dec., 1893, pp. 15, figs. 6*).

Synopsis.—Seeds of parsnips, lettuce, carrots, turnips, beets, salsify, radishes, and onions were planted on a bed of rich, moist soil with noninsulated copper wires 2 inches below the surface connected with a dynamo, and on a similar bed not subject to the electric influence. The current was applied about four hours daily. On the electric bed parsnips, salsify, and radishes made a larger yield of tops and roots than on the bed used as a check. Carrots made a heavier yield of roots on the electric bed. With lettuce and Purple Top turnips the result was apparently in favor of electricity; Sweet German turnips and Egyptian Turnip beets gave a smaller yield of tops and roots on the electric bed. Peas on the electric bed came up three days before those on the check bed. Electricity hastened the ripening of tomatoes.

Two plats of ground each 6 by 20 feet were used for the experiment. One was used as a check. Around the other "was constructed a framework, made of 2 by 4 inch timbers, on which were fastened porcelain insulators, 4 inches apart; a continuous noninsulated copper wire (No. 15) was strung on these porcelain insulators, and the whole structure was then buried so that the wire should be 2 inches below the surface of the ground. Near at hand was a transformer, a small house in which were placed switches, meters, voltmeter, ammeter, reducer, and resistance lamps." June 8, seeds of parsnips, lettuce, carrots, Sweet German turnips, Purple Top White Globe turnips, beets, salsify, Early French Breakfast radish, White Strasburg radish, and onions were planted in

both beds, the seeds in the electric bed being sown midway between the wires. During the experiment the ground was kept well watered in order that it might act as a good conductor. "Perfect control of the currents was obtained throughout the whole time the experiment was in progress. Electricity was generated by the dynamo at the electric light station. The current was alternating and was applied nightly, from time of turning on the current at the generating house until after 11 o'clock, or about four hours daily, from June 10 to October 1, inclusive."

From June 10 to July 18 the current varied from 12 to 39 ampéres and between July 13 and September 30 it was maintained at 39 ampéres. The voltage varied from 15 to 53. The more decisive results are expressed in the following table:

Effect of electricity on vegetables.

Vegetables.	Weight of crops.		Vegetables.	Weight of crops.	
	With electricity.	Without electricity.		With electricity.	Without electricity.
	Lbs. Ozs.	*Lbs. Ozs.*		*Lbs. Ozs.*	*Lbs. Ozs.*
Carrots:			Transplanted beets:		
Roots	13 12	13 ..	Roots	6 ..	7 8
Tops	1 8	1 8	Tops	2 ..	1 12
Total	15 4	14 8	Total	8 ..	9 14
Parsnips:			Salsify:		
Roots	17 10	14 5	Roots	2 6	1 10
Tops	17 ..	10 ..	Tops	1 11	1 8
Total	34 10	24 5	Total	4 1	3 2
Sweet German turnips:			Early French Breakfast radishes:		
Roots	23 ..	28 8	Roots	5 4	4 2
Tops	6 12	8 ..	Tops	4 5	2 14
Total	29 12	36 8	Total	9 9	7 ..
Beets:					
Roots	3 8	7 8			
Tops	1 7	1 12			
Total	4 15	9 4			

Lettuce did not germinate well, but the few plants which grew appeared to be favorably affected by electricity. White Strasburg radishes and Purple Top White Globe turnips made a larger growth on the electric bed than on the check. The crop of onions was a total failure on both beds. The parsnips came up earlier and grew faster on the electric bed. "It was also noticed that those plants in the immediate vicinity of the point where the current emerged from the ground by the return wire grew faster and were much larger than those at a greater distance from the electrodes." On the electric bed one third of a row of parsley which had been accidentally planted in close contact with an electric wire grew more rapidly than the rest.

American Wonder peas were sown at a depth of 1 inch and touching the electric wire. The plants in the electric bed appeared above ground three days before those in the bed used as a check, developed a finer foliage, and blossomed three or four days sooner.

August 3, eight noninsulated wires were placed among the roots of

three tomato plants of the Champion variety. A current of 39 ampères was used. The fruit on the plants thus treated invariably ripened three to four days earlier than the fruit of other plants used as a check.

Growing vegetables by electricity was considered by the author as scarcely practical.

Experiments with vegetables, J. CLAYTON (*Alabama College Sta. Bul. No. 51, Oct., 1893, pp. 8*).—Notes on 23 varieties of tomatoes, 7 of potatoes, and brief notes on cabbages, eggplants, onions, bush Lima beans, and Conover Colossal asparagus.

Cuttings about 10 inches in length from the Matchless tomato were planted August 10 and bore a heavy crop in October. The author recommends the middle of July as a better date for planting tomato cuttings than the middle of August. Of 7 varieties of potatoes planted, the largest yield was from Early Rose. Among early cabbages preference is given in the order named to Early Summer, Succession, and All Seasons; among late kinds, to Large Late Drumhead and American Drumhead. Brief directions are given for the culture of eggplant and of onions grown from seed. Of 15 varieties of onions the following were recommended, having made a fair growth the first season from seed: Large Tripoli, Silver King, New Pearl, New Queen, White Barletta, White Maggiajola, and Red Wethersfield. Henderson New Bush Lima bean was earlier and more prolific than either Burpee or Dreer Bush Lima. Beets, lettuce, carrots, salsify, radishes, and young plants of Conover Colossal asparagus were successfully grown. A limited quantity of asparagus plants, grape roots of the standard varieties, and seed of White Velvet okra, Jones and Sugarloaf watermelons, and Pineapple and Nixon cantaloupes will be distributed to residents of the State on payment of postage.

Report of horticulturist, M. H. BECKWITH (*Delaware Sta. Report for 1892, pp. 81–101*).—An experiment in growing tomatoes under glass, variety tests of tomatoes, strawberries, currants, gooseberries, and raspberries, and a list of varieties of peaches growing in the experimental orchard.

Tomatoes, culture under glass (pp. 81–87).—Tomato plants were grown on greenhouse benches, which contained about 7 inches of soil, consisting of three fourths rich clay loam and one fourth well-rotted stable manure. The plants were set 16 to 18 inches apart and trained to a single stem. The first fruits ripened April 8, one hundred and twenty-four days after planting the seed. Tabulated data give the yields of tomatoes made on seven beds differently treated. The yield per plant varied between 13.4 and 43.3 ounces; the yield per square foot, between 3.77 and 21.6 ounces. Drainage by means of coal cinders and broken pots placed in the bottom of the benches largely increased the yield. Directions for caring for tomato plants under glass and for pollinating the blossoms are given.

Tomatoes, test of varieties (pp. 87-89).—A list of 45 varieties tested and a statement of the date when each ripened its first fruit; also brief descriptive notes on 18 varieties.

Strawberries, test of varieties (pp. 89-92).—A list of 59 varieties, with date of first bloom, first ripe fruit, and length of bearing season; also notes on 54 varieties.

Variety tests of peaches, currants, gooseberries, and raspberries (pp. 97-101).—A list of 257 varieties of peaches growing in the experimental orchard on a farm near Seaford, Sussex County, and date of first bloom and of first ripe fruit of 4 varieties of currants, 5 of gooseberries, and 11 of raspberries; also notes on 9 varieties of raspberries and on Child Japanese wineberry.

The tomato, P. H. ROLFS (*Florida Sta. Bul. No. 21, Oct., 1893, pp. 1-19*).—A popular discussion of the history, botany, culture, and manurial requirments of the tomato, with a scale of points for the ideal tomato, and brief notes on 12 varieties.

Some experiments with blackberries, dewberries, and raspberries, S. A. BEACH (*New York State Sta. Bul. No. 63, n. ser., Dec., 1893, pp. 665-691*).—*Blackberries* (pp. 665-671).—Notes on 34 varieties and tabulated data giving the yield and date of fruiting of 23 varieties. The most productive blackberry in 1893 was Dorchester, followed by Ancient Briton, Early Harvest, and Agawam, in the order named.

Dewberries (pp. 671, 672).—The Lucretia dewberry was more productive than the Bartel or Mammoth. Two unknown varieties received from Arkansas proved too tender for the latitude of the station, at least without winter protection.

Raspberries (pp. 672-691).—Notes and tabulated data for 7 purple, 9 yellow, 19 black, and 31 red raspberries. Of the black raspberries the most productive were Mills No. 7, Mills No. 15, Hilborn, and Spray Early, in the order named. Of the black varieties tested, Spray Early gave the largest yield prior to July 10 and Mills No. 15 gave the largest yield after July 20. Of 7 purple varieties tested Columbian was the most productive. Of the 31 red raspberries, Pomona, Coleman No. 1, Rancocas, Montclair, Early Pride, and Pride of Kent ripened over 12 per cent of their crop before July 13. Pomona was the most satisfactory early red raspberry tested, and its fruiting season was long. Pomona for early fruit and Royal Church for late fruit are recommended as an excellent combination for the home garden. Of 9 varieties of yellow raspberries, Caroline was the most productive.

Trial of lawn grasses, L. F. KINNEY (*Rhode Island Sta. Report for 1892, pp. 213, 214*).—In 1890 four plats of ground were prepared and seeded for lawn. The first section received Rhode Island bent grass, and with the second Kentucky blue grass, while the third and fourth were repetitions of Nos. 1 and 2 white clover added to each. In the first year the Rhode Island bent grass made the thickest and most even sward.

During the seasons of 1891 and 1892 the lawn received no special treatment, the clover plants were gradually driven out, and the Kentucky blue grass plat appeared better than the Rhode Island bent grass. The Rhode Island bent grass turns yellow earlier in the fall and remains brown later in the spring. Small bare spots, caused by the Rhode Island bent grass dying out, were numerous in sections 1 and 3.

The results of the trial and the observations of the behavior of these grasses in other localities seem to indicate that the most satisfactory lawn grass might be obtained by a mixture of equal quantities of the two grasses. The addition of the clover seed did not improve the condition of the sward, but made it of uneven growth and hard to cut smoothly.

WEEDS.

WALTER H. EVANS, *Editor.*

The Russian thistle in Nebraska, C. E. BESSEY (*Nebraska Sta. Bul. No. 31, Dec., 1893, pp. 67–77, plates 5*).—A popular bulletin on the subject of the Russian thistle, compiled largely from Farmers' Bulletin No. 10 of this Department (E. S. R., vol. IV, p. 669), together with extracts from other publications relating to the origin, spread, and troublesomeness of this weed. The weed laws of Wisconsin and Nebraska are quoted, with suggestions for their modification so as to include the Russian thistle.

DISEASES OF PLANTS.

WALTER H. EVANS, *Editor.*

Report of the mycologist, F. D. CHESTER (*Delaware Sta. Report for 1892, pp. 53–80, figs. 2*).

Synopsis.—The following articles are treated in this bulletin: Can peach rot be controlled by spraying? Diseases of the round potato and their treatment; Anthracnose of watermelons; and Anthracnose of the tomato.

Can peach rot be controlled by spraying? (pp. 53–66).—A reprint from Bulletin No. 19 of the station (E. S. R., vol. IV, p. 835).

Diseases of the round potato and their treatment (pp. 67–75).—A report on the treatment of potatoes for potato rot (*Phytophthora infestans*), *Macrosporium solani*, and potato scab. Popular descriptions are given of these diseases and the use of Bordeaux mixture for the potato blights and corrosive sublimate for the scab are tested, with results more or less contradictory.

Anthracnose of the watermelon (pp. 75–79).—The author's attention was called to dead vines affected by some fungus. Where the stalk was yet green it was found to be covered with elongated dark patches and irregular areas; the tendrils, buds, and leaf stalks were invariably black and dead, and the leaves were covered with black blotches,

marked by more or less concentric rings. The mycelium of the fungus, which proved to be from its fruiting a member of the form genus *Phyllosticta*, was easily demonstrated.

During the winter of 1892 the author grew some watermelon plants in the greenhouse and experimented with cultures made from the diseased tissues, and succeeded in reproducing the disease as seen the fall before. While this experiment was in progress watermelon leaves picked from the vines in the fall for examination and pressed for herbarium specimens were put in a moist chamber, and in from ten to fourteen days numerous pustules began to appear upon the dead spots. When subjected to microscopic examination they were recognized as the pycnidia of the same *Phyllosticta*, but associated with them were the fruiting characteristics of the genus *Sphærella*. Specimens gathered during the summer of 1892 showed the same characteristic discoloration on stalk, tendril, leaf stalk, and leaves, but upon examination there was recognized an anthracnose, presumably *Glœosporium lagenarium*. Further examination later in the season showed that the spore-bearing layer occasionally developed setæ, which character places the fungus in the genus *Colletotrichum*. That the *Phyllosticta* and *Sphærella* may be stages in the life history of the *Colletotrichum* is a hypothesis the author hopes to settle by further study. At present there is no doubt that they have been found upon identical spots in three fruiting forms probably products of the same mycelium.

In addition to the watermelon the fungus has been observed on citron, squashes, and pumpkin. A trial of Bordeaux mixture for this anthracnose apparently gave no result.

Anthracnose of the tomato (p. 80).—In the Annual Report of the station for 1891 (E. S. R., vol. v, p. 591), the author describes a new disease of the tomato caused by the fungus *Colletotrichum lycopersici*. His specimens this year showed an abundant development of setæ, but in 1892 the specimens were without the setæ, and to all appearance the fungus was a *Glœosporium*. The question arises whether the presence or absence of setæ is of sufficient generic importance to separate the two genera. From a mycological standpoint the author sees no reason to separate the two forms as seen in the disease upon the tomato.

Celery leaf blight, G. C. DAVIS (*Michigan Sta. Bul. No. 102, Dec., 1893, p. 52*).—Brief notes on the occurrence of celery blight (*Cercospora apii*) in the State. The following note by Mr. B. T. Galloway, of the Division of Vegetable Pathology of this Department, contains some unpublished observations relating to this disease:

Celery leaf blight, caused by *Cercospora apii*, is an exceedingly destructive disease, especially in the eastern part of the United States. For several years we have been making experiments in the hope that some means of cheaply preventing the trouble might be discovered. In 1890, 1891, and 1892 a number of trials made were with various fungicides, including both liquids and powders, but none of these gave very satisfactory results. In every case where the celery was planted on upland soil it

blighted badly, despite the fact that the leaves were kept nearly covered with such well-known fungicides as Bordeaux mixture, ammoniacal solution of copper carbonate, etc. Where these preparations were used, however, the celery was not so badly attacked by leaf blight as the plants receiving no treatment at all.

Noticing that celery on low moist ground was seldom severely injured by blight, an experiment was made in 1892 on upland soil to test the effect on the disease of water applied to the roots. The plants selected for the experiment were fully exposed to the sun and were set in such a way that they could be flooded sufficiently often to keep the ground always soaked. Without any further treatment these plants made a vigorous growth and were almost wholly free from blight. The average height of the plants when bleached was 32 inches. Plants in the same bed which received only water falling naturally, as rain, blighted very badly, in consequence of which there were not enough leaves to bleach when the time came for this operation. In height these plants averaged a little over 8 inches, or about one fourth that of the watered celery. The experiment shows the importance of an abundant water supply for this crop and explains in a measure why in certain localities celery is seldom affected with the disease. Of course it may not be practicable for all upland celery growers to water as extensively as seems necessary to keep the crop growing and free from disease; still there are no doubt many places where irrigation could be practiced at comparatively little expense, making the crop, even in regions where the soil and climate are naturally unfavorable, a certain and profitable one.

Experiments in the treatment of potato blight and potato scab, L. F. KINNEY (*Rhode Island Sta. Report for 1892, pp. 209–213*).—All potato vines at the station were sprayed during the past season, with the exception of a few rows left as checks, to prevent attacks of potato blight. The increased yield of large potatoes due to treatment was estimated as about one fourth of the crop. The earlier varieties gave the least increase and the later varieties the most. A field of late Beauty of Hebron potatoes was treated with Bordeaux mixture, three applications being given as follows: July 16, July 29, and August 9. At the time of the latest application the check rows gave an evidence of the presence of the blight, while the treated rows were but very slightly attacked in spots. By the first of September the check rows had become dry and brown, while the foliage of the treated ones remained green. The effect of the treatment upon the crop was very marked, the yield being almost doubled by it, and the tubers were of a much larger and fairer quality. Another field of the same variety was treated, three applications being given, and the potatoes dug September 22, when it was determined that the average yield of tubers had been increased 21.7 per cent, or about 41½ bushels per acre, by treating the vines with Bordeaux mixture. The cost of the treatment was about $6 per acre.

For potato scab four fungicides were used, as follows: Bordeaux mixture, fostite, Powell's copperdine, and corrosive sublimate. Eight rows of potatoes, each 50 feet long, were used in the experiment, four receiving treatment, the other four being reserved as checks. The seed potatoes in row A were sprayed with Bordeaux mixture, in row C they were dusted with fostite, in row E they were sprayed with Powell's copperdine, and in row H they were soaked in a solution of corrosive sublimate (1 part to 1,000 of water) for two hours before planting. In every

case but the last a greater total yield of potatoes was secured from the check rows. The scabby potatoes harvested from the rows treated with fungicides were as follows: Bordeaux mixture 22 per cent, fostite 26 per cent, Powell's copperdine 29 per cent, corrosive sublimate 9 per cent. The yield of the untreated rows contained from 35 to 42 per cent of scabby potatoes. In every case the product from the treated rows was less scabby than that from the parallel untreated ones, the average excess of scab in the untreated rows being about 74.4 per cent.

Fungus enemies of the tomato, P. H. ROLFS (*Florida Sta. Bul. No. 21, Oct., 1893, pp. 25–38, figs. 2*). This bulletin contains notes on the blight, black rot, and dropping of buds.

Tomato blight (pp. 25–36).—The blight of tomatoes, as studied at this station, affects quite a number of plants in addition to the tomato, having been found upon the tomato, eggplant, potato, bean, cowpea, squash, cabbage, beet, watermelon, hydrangea, and various species of weeds. The cause of the blight has been determined as a species of *Sclerotium*. Under ordinary conditions the fungus can not be seen with a microscope, but by using pico-carmine the mycelium may be seen permeating the tissues of the host. By means of numerous cultures the author has demonstrated that this is the cause of the blight of that region. Bordeaux mixture, ammoniacal copper carbonate, and eau celeste were used as preventive remedies for this disease, with considerable success.

Black rot (pp. 36, 37).—*Macrosporium solani* is widely disseminated throughout the State, and tests of fungicides proved that Bordeaux mixture, if properly applied, is very efficient in the prevention of this disease.

Dropping of buds (pp. 37, 38).—Under this head the author mentions several obscure diseases of uncertain origin, one causing the falling of buds just after blooming, and another resulting in the crumpling and drying of the leaves as though burned. These diseases, for which no remedies are yet known, are to be the subject of further study.

ENTOMOLOGY.

Report of the entomologist, M. H. BECKWITH (*Delaware Sta. Report for 1892, pp. 102–109, figs. 2*).—The author gives a brief report upon the corn bollworm, notes on the strawberry weevil, and experiments in destroying white grubs.

The corn bollworm (*Sphenophorus sculptilis*) is briefly described. The insect seriously injures corn by feeding upon the young plants before they are up, piercing them with its beak, and chewing and devouring the inner parts. As the leaves of the injured plant unroll, rows of parallel oblong holes extending across the leaf may be seen. This arrangement of holes is due to the fact that the insects puncture

the young plants with their beaks, penetrating through the rolled leaves, making several holes by a single puncture.

Two rows of corn were treated with a mixture of London purple and air-slaked lime by dropping a small handful of the mixture upon each hill. At the same time bunches of freshly cut green clover or timothy poisoned with London purple in water were placed upon the ground between the rows of corn. No advantage could be discovered from the treatment of the rows with London purple. Cultivation of the corn field was recommended and the insects disappeared at once. An examination of the field on the first of June revealed few beetles, but a considerable number were found in the roots of timothy in an adjoining field. The best remedy, therefore, seems to be the cultivation or the soil as soon as the insects are found to be working on the corn.

Popular descriptions and illustrated notes are given on the habits of the strawberry weevil. The use of arsenites upon strawberry plants is condemned, lest fatal consequences should follow from the poisoning of the fruit. Kerosene and white hellebore are recommended to be used, and formulas are given for each.

An experiment was attempted to destroy the white grubs by means of the fungus *Botrytis tenella.* Tubes containing the spores of this fungus were received from France, where it has been given favorable mention as rapidly destroying the white grubs. The author treated 125 grubs in accordance with the directions accompanying the tubes, and at the end of ten days from the time of treatment several showed the characteristic color and mummy-like consistency that those affected with the disease are said to assume. The remaining grubs appeared lively and as healthy as at the beginning of the treatment. Other tests were made, but the fungus failed to spread from those inoculated to the healthy grubs contained in the same boxes.

Celery insects, G. C. DAVIS (*Mich. Sta. Bul. No. 102, Dec., 1893, pp. 23–51, figs. 20*).—The bulletin consists of illustrated descriptions, life histories, and notes on the repression of insects affecting celery, together with frequent references to literature. The more destructive species enumerated are locusts, grasshoppers, leaf hoppers, tarnished plant bug, the little negro bug (*Corimelæn apulicaria*), three-lined thrip (*Coleothrips trifasciata*), celery aphis, celery aphalaria, celery beetles, celery caterpillar, zebra caterpillar, spotted cutworm, celery plusia, celery borer, sulphur-colored tortrix, celery tortrix, and red spider. The following new species of leaf hoppers are described by Mr. E. P. Van Duzee:

Athysanus instabilis.—"Form of *Deltocephalus inimicus* Say. Black, dotted and marked with fulvous as follows: Hind edge of the vertex a dot, sometimes wanting, touching this either side of the middle, another near each eye, two marks on the disk, a line before each of these, an angular mark at apex including a short longitudinal dash, a dot on the temples, six or eight arcs and the central line on the front, the latter expanded on the clypeal suture, two dots on the base of the clypeus,

another on each lora, a spot on the cheeks and their slender outer edge, the irrorations of the pronotum and a few large spots on its anterior edge, six spots on the scutellum—four marginal and two discal—and its median line, knees, a transverse band on the femora and the slender hind edge of the abdominal segments. Posterior legs pale, more or less clouded with fuscous, with the inner face of the flattened tibia black. Elytra pale, slightly clouded at apex, the areoles broadly margined with fuscous, nervures whitish. Last ventral segment of the female long, feebly arquated either side of the middle, with the lateral angles prominent. Valve of the male short, plates triangular subacute. Length 4 to 4½ mm."

Quite common at the college through August and September. Mr. Van Duzee has the specimens of the same species from Colorado also.

Megamelus piceus.—"Piceous-black; base of the vertex, keels and narrow hind edge of the pronotum, disk of the mesonotum, or at least its carinæ, disk of the tergum, especially towards its base and apex, and the edge of the dorsal keel, the genital segments, and sometimes the base of the venter, brownish yellow. Face pale shaded to brown above, clypeus deep black. Antennæ, rostrum, tylus, and legs pale, soiled yellow, the latter lineate with brown. Elytra reaching to the second abdominal segment in the branchypterous form, with the apex truncated, piceous-brown, or even black, with the apical edge white more or less broadly interrupted with black at the middle; nervures strong, granulated. In the macropterous form the elytra extend considerably beyond the tip of the abdomen about as in *Liburina pellucida;* they are smoky with pale granulated nervures, the exterior and interior of which are forked at about three fourths their length. Pygafers of the male cylindrical, on their ventral aspect cut out for about one half their length and carrying on the broad base of this incisure a broad and short projection extended into a short conical divergent tooth at each angle; beyond this are the incurved spine-like stylets included between the long slender ventral projections of the plates. Length 2½ to 3 mm.

"New York and Michigan. Described from many examples of both sexes taken in western New York on grass in low swampy meadows in August and September, and one female taken on celery at Kalamazoo, Mich., August 26, 1893, by Mr. G. C. Davis."

A remedy for the rose bug, L. F. KINNEY (*Rhode Island Sta. Report for 1892, pp. 214, 215*).—The rose bug (*Macrodactylus subspinosus*) having been abundant in 1892, it was supposed it would appear last year as usual. In order to save the fruit buds in the vineyards the vines were sprayed the first week in June with Bordeaux mixture and Paris green, in the proportion of 50 gallons of the former to 1 pound of the latter. Care was exercised to make the application before the flower buds opened. If delayed until the vines blossom, more or less injury might result. As a result of this and two other applications of Bordeaux mixture alone, which were made to prevent attacks of mildew and black rot, the vines matured a fine crop of grapes. The attack of the rose bugs, which appeared in great numbers, was not appreciable.

Insect enemies of the tomato, P. H. ROLFS (*Florida Sta. Bul. No. 21, Oct., 1893, pp. 19–25*).—Popular notes are given on the bollworm (*Heliothis armigera*), *Phytoptus* spp., and nematodes.

Insecticides and their appliances, H. E. WEED (*Mississippi Sta. Bul. No. 27, Nov., 1893, p. 24, figs. 28*).—This bulletin consists of a popular report on insecticides and their application. Formulas are given

for 8 standard insecticides and 17 special ones. Descriptive illustrated notes are given on different forms of spraying apparatus.

Mineral residues in sprayed fruits, R. C. KEDZIE (*Michigan Sta. Bul. No. 101, pp. 19-21*).—Analyses are given of samples of strawberries, red cherries, white cherries, Russian cherries, red currants, raspberries, gooseberries, pears, and plums, which had been sprayed with a mixture of Bordeaux mixture and London purple, with Bordeaux mixture alone, and with a weaker Bordeaux mixture. In every case copper or arsenic was found on the fruit.

The inquiry naturally arises whether these poisons merely adhere to the surface or penetrate the substance of the fruit. The results with gooseberries seem to show that they penetrate the body of the fruit to a limited extent. A test of this question has been made with some of the sprayed pears. A pound of the pears was selected, the skin carefully pared off and burned by itself, and the body of the pear burned to ashes by itself, and each ash separately analyzed. The pear peelings from 1 pound of pears gave 0.106 grain of copper salt, and the flesh gave 0.071 grain, showing that while most of the copper salt adheres to the surface, a portion finds way into the body of the fruits.

The copper salts adhere to vegetable surfaces more persistently than is commonly supposed. A student in chemical analysis during the first week in May, 1893, made some investigations on this subject. The outside bark of trees that had been sprayed with Bordeaux mixture was gathered, burned to ash, which was dissolved in nitric acid, and the copper plated out on a platinum dish and weighed. The results are calculated for 100 square inches of bark surface. The bark of a tree that was sprayed April 18, 1893, gave 0.124 grain of metallic copper. The bark of a tree more recently sprayed, and on which the spray was still visible, gave 0.28 grain of copper. The bark of an apple tree sprayed about one year before gave 0.05 grain, and the bark of a plum tree sprayed about June 1, 1892, gave 0.044 grain of copper. * * *

The use of poisons in horticulture, in my opinion, is largely in excess of the amount required for a fungicide. One half or even one third of the amount usually employed would probably give as good results.

In the spraying of some fruits, such as strawberries, in 1892, the amount was purposely used in large excess. In one case nearly 5 grains of blue vitriol were recovered from 1 pound of fruit—a dose no sensible person would want to take in his food. Yet, even that dose would not probably be fatal, though it might cause vomiting. Any of the doses of arsenic or of copper found in a pound of these fruits might be swallowed without endangering life by such single dose. It is the repeated doses, day by day, of such poisons that might produce slow poisoning and the gradual undermining of the health, without obvious cause. It is safe to refuse all fruits which have been sprayed with these poisons (especially arsenic) during the period of ripening.

Report of the apiarist, S. CUSHMAN (*Rhode Island Sta. Report for 1892, pp. 247, 248*).—Sixteen colonies prepared for wintering in the fall of 1891 came through without loss of a single colony. The season was an unusually good one for honey, the 16 colonies yielding 839 pounds of extracted honey and 87 pounds of honey in the comb, the three best hives yielding 84½, 86¼, and 117 pounds, respectively.

FOODS—ANIMAL PRODUCTION.

E. W. ALLEN, *Editor.*

Feeding stuffs, C. L. PENNY (*Delaware Sta. Report for 1892, pp. 124–126*).—Tabulated analyses of cowpea vines, shredded corn fodder, sugar corn, cowpea silage, silage corn, and sweet-corn silage. Analyses of two samples of cowpea vines and one of sweet-corn fodder, and of the silage made from the same, are given as follows:

Analyses of cowpea vines and sweet-corn fodder, and silage made from the same.

	Water.	In dry matter.				
		Crude protein.	Crude fat.	Crude fiber.	Nitrogen-free extract.	Ash.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Cowpea vines	....	15.60	3.07	29.46	44.77	7.10
Silage made from same	76.94	15.00	2.72	35.04	40.30	6.94
Cowpea vines	77.07	11.61	2.35	30.34	49.44	6.26
Silage made from same	71.10	12.79	3.82	30.11	44.23	9.05
Shredded sweet-corn fodder	75.48	7.94	1.02	28.59	56.72	5.73
Silage made from same	74.10	8.10	1.43	28.81	55.11	6.49

Adulteration of ground feed, R. C. KEDZIE (*Michigan Sta. Bul. No. 101, pp. 17–19*).—It was found that oat hulls and corn bran were widely used for adulterating the mixture of oats and corn known as ground feed. A letter from a leading commission house states that ground feed, or "chop," is commonly made by grinding a mixture of oats, corn, screenings, barley, malt sprouts, and various other products. Analyses are given of the oat hulls and corn bran, and these are compared with analyses of oat straw. An analysis is also given of gluten feed. "Almost the entire amount of crude protein in gluten feed is in the form of albuminoid, 36 per cent, while only 0.37 of 1 per cent is in the form of amide compounds."

Report of the poultry division of Rhode Island Station, S. CUSHMAN (*Rhode Island Sta. Report for 1892, pp. 216–246, figs. 3*).—An introductory discussion is given on the laws of breeding, cross breeding, selection, and mating of breeding stock, qualities desired in a table fowl, etc., followed by a description of experiments carried out at the station in crossing pure-bred fowls. The breeds used were Indian Game, White Wyandotte, Golden Wyandotte, Buff Cochin, Houdan, Silver-gray Dorking, Silver Duckwing Game, Plymouth Rock, Light Brahma, Dark Brahma, and Partridge Cochin, and with these sixteen different crosses were made.

A description of some of the more desirable crosses is given as follows, the male of the cross being mentioned first:

Indian Game and Light Brahma.—Cockerels, plumage similar to Light Brahma but darker, with some yellow. Larger than Brahma and between the two in shape, comb and wattles the same as Brahma. Body wide, legs long.

Pullets, plumage brown with penciled feathers, dark hackles. Resemble Brown

Malay hens except in the slight leg feathering. Lay well; eggs as large as Brahma eggs. Each sex is as uniform in size and in color as a pure breed. They are hardy, quiet, good feeders, and are closely feathered. There was hardly ai y loss among the chickens. A very desirable cross.

Indian Game and Houdan.—Plumage black, or slightly mixed with white, small crests. Cockerels have flesh-colored legs, and pullets dark legs. Are active, grow quick, and fairly hardy. There is not much difference in size between cockerels and pullets. Are uniform in appearance.

Indian Game and Golden Wyandotte.—In plumage and appearance most like Golden Wyandotte. Markings uniform. Fairly hardy, quick, active, and plump at any age. Disposition rather excitable. Cockerels much larger than pullets. But slight loss among chickens.

Indian Game and Buff Cochin.—None but pullets reared. Similar in plumage and appearance to Light Brahma cross. Not so closely feathered, legs shorter and more feathers on them. Larger and brighter comb.

White Wyandotte and Light Brahma.—In appearance between the two. Both rose and single combs appear. Body more stocky than Brahma; legs shorter, plumage faded and muddy. Show more red in comb and face than Brahmas. Disposition quiet. Good feeders and hardy. Cockerels grow very large.

White Wyandotte and Indian Game.—Plumage similar to Silver Wyandotte, dark with gray neck; breast feathers in pullets slightly spangled with white; legs and neck short; rose comb. Grow quickly, and are always plump and hardy. Pullets are excellent layers. Cockerels not much larger than the pullets. A desirable cross.

Houdan and Partridge Cochin.—Plumage a mixture of the two. Small crests; legs both light and dark and feathered; active; quick growers.

Silver-gray Dorking and Dark Brahma.—Cockerels, plumage similar; larger pea comb; legs short and feathered; long body; hardy. Pullets large, Dorking shape and plumage; feathered legs; single comb. Very bright and thrifty. Good layers. Uniform in size and plumage, and handsome. An excellent cross for both utility and beauty.

Silver Duckwing Game and Dorking.—Plumage the same and very handsome. Single comb and willow legs. Body plump. Pullets great layers of small white eggs. Good for table but best for eggs.

The various crosses, both alive and dressed, were exhibited at the Rhode Island poultry exhibition in December. A description of the carcasses of each cross is given, together with data as to the live weight at time of killing and the loss on dressing. The judges pronounced the cross of Indian Game on Light Brahma the best specimen of dressed poultry, followed by the crosses of White Wyandotte on Indian Game, White Wyandotte on Light Brahma, Indian Game on Golden Wyandotte, and Dorking on Dark Brahma. The judgment was made in accordance with the popular demand for yellow poultry.

Judging from these experiments, the raiser of market poultry will not make a mistake if he crosses Indian Game cockerels or cocks on Light Brahma hens, or on any variety of Wyandotte hens; or Wyandotte males on Indian Game hens or Light Brahma hens. It was found that Indian Games and their crosses were harder to pluck and more difficult to caponize than any other of the crosses.

The article closes with an illustrated description of the station brooder house.

Diseases of farm stock, A. T. NEALE (*Delaware Sta. Report for 1892, pp. 45–52*).—Notes on cerebro-spinal meningitis, anthrax, and bovine tuberculosis.

DAIRYING.

E. W. ALLEN, *Editor.*

Centrifugal cream for ice cream, C. L. PENNY (*Delaware Sta. Report for 1892, pp. 123, 124*).—In view of the objection of ice cream manufacturers to centrifugal cream, eight separate experiments were made of making ice cream from cream raised by the Cooley system, by the open bowl DeLaval separator, and by the Alpha DeLaval separator. In each case 1,300 c. c. of cream and 325 grams of sugar were taken, and the ice cream was made by a man accustomed to the work. The results showing the increase of volume in freezing and the quality of the product are tabulated.

The increase in volume averaged about 50 per cent. It did not appear to depend on the proportion of fat in the cream and was quite irregular. The ice cream made from cream raised by the Cooley system seemed to be of slightly better quality than that made from the separator cream, although it is believed that "the treatment of the cream after skimming or separation, its age, temperature, and acidity, have probably very much more to do with the quality of the product than the manner of separating the cream from the milk."

Hand-power cream separators, C. L. PENNY (*Delaware Sta. Report for 1892, pp. 110–123, figs. 4*).—This includes a reprint of Bulletin No. 17 of the station (E. S. R., vol. IV, p. 188), together with a method for estimating the amount of power required to run separators.

AGRICULTURAL ENGINEERING.

Soil improvement by vertical drainage, A. T. NEALE (*Delaware Sta. Report for 1892, pp. 30, 31*).—The construction of vertical drains or wells extending down to water-bearing strata for drainage of basins which can not be drained by ordinary methods is explained and an account is given of the successful practice of the method of the station on a piece of land on which crops of corn and crimson clover had been drowned out. The well is 12 feet deep and 6 feet in diameter. "It is bricked up and decked over; from it four ordinary 3-inch drains, varying in length from 50 to 75 tiles each, are laid 2 feet below the surface."

Tests of farm machinery, A. T. NEALE (*Delaware Sta. Report for 1892, pp. 39–45*).—Tests were made of the following implements: Reeves crimson clover seed huller, a gang plow drawn by a traction engine, Leonard corn harvester, and Keystone corn husker. The crimson clover on which the clover seed huller was tested contained large admixtures of green immature growths, and more than 50 per cent of the seed had been beaten out by the wind. In three hours 12,877 pounds of such straw and seed were passed through the machine, yielding 1,030 pounds of clean merchantable seed, or 80 per cent of the available seed.

A gang plow drawn by a traction engine failed utterly in plowing under lodged crimson clover. Under other conditions it was reported as doing good work at an expense of 42 cents per acre.

The Leonard corn harvester cut and handled straight corn very rapidly, but failed where the stalks were bent, twisted, or broken by the wind. In two separate trials it proved too severe on the horses and on the operator.

Shredded fodder from the Keystone corn husker was ensiled, and a similar weight of the same fodder was moistened with water while the packing in the silo progressed. A gain of 13.4 per cent in storage capacity resulted from this spraying. The silos have not yet been opened.

STATION STATISTICS.

Sixth annual report of Alabama College Station (*Alabama College Sta. Report for 1893, pp. 23*).—This includes the treasurer's report for the fiscal year ending June 30, 1893, and short reports by the botanist, agriculturist, biologist, chemist, and veterinarian of the station. These reports are for the most part statements of work accomplished during the year or that in progress in the several departments.

Report of treasurer of Delaware Station (*Delaware Sta. Report for 1892, pp. 4, 5*).—This is for the fiscal year ending June 30, 1892.

Report of director of Rhode Island station (*Rhode Island Sta. Report for 1892, pp. 117–128, 252–255*).—A brief report on the work of the year, a list of the bulletins published, acknowledgments of publications presented to the station, and a list of exchanges.

Report of treasurer of Rhode Island Station (*Rhode Island Sta. Report for 1892, pp. 256–258*).—This is for the fiscal year ending June 30, 1892.

Annual report of Virginia Station (*Virginia Sta. Report for 1892, pp. 14*).—This consists of very brief reports by the director, biologist, chemist, veterinarian, agriculturist, horticulturist, entomologist, and mycologist, together with the treasurer's report for the fiscal year ending June 30, 1892.

Report of treasurer of West Virginia Station (*West Virginia Sta. Fourth Annual Financial Statement, pp. 3*).—This is for the fiscal year ending June 30, 1891.

ABSTRACTS OF PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE.

Recent features of our foreign trade, E. T. PETERS (*Division of Statistics, Miscellaneous Report No. 8, pp. 24*).—This article contains statistical data and discussions on the following topics: Value of our exports and imports, exports of merchandise, 1891–'93, exports of agricultural products, relation between exports and harvests, our imports and their overvaluation, special causes for increase of certain imports, our large gold exports, and the absence of adverse balances in merchandise.

In the following table the value of our exports of gold, silver, and merchandise, respectively, for the fiscal year ending June 30, 1893, is given in comparison with the values for the two preceding fiscal years:

Value of our exports and imports for the fiscal years ending June 30, 1893, 1892, and 1891.

Fiscal year ending June 30—	Gold.	Silver.	Gold and silver.	Domestic merchandise.	Foreign merchandise.	Total merchandise.	Grand total.
1893.							
Exports	$108,680,844	$40,737,319	$149,418,163	$830,876,908	$16,631,116	$847,508,024	$996,926,187
Imports	21,174,381	23,193,252	44,367,633	....	....	*941,361,421	*985,729,054
Excess of exports over imports	87,506,463	17,544,067	105,050,530	....	....	....	†11,197,133
Excess of imports over exports	....	....	....	....	....	*93,853,397	
1892.							
Exports	50,195,327	32,810,559	83,005,886	1,015,732,011	14,546,137	1,030,278,148	1,113,284,034
Imports	49,699,454	19,955,086	69,654,540	....	....	827,402,462	897,057,002
Excess of exports over imports	495,873	12,855,473	13,351,346	....	....	202,875,686	216,227,032
1891.							
Exports	86,362,654	22,590,988	108,953,642	872,270,283	12,210,527	884,480,810	993,434,452
Imports	18,232,567	18,026,880	36,259,447	....	....	844,916,196	881,175,643
Excess of exports over imports	68,130,087	4,564,108	72,694,195	....	....	39,564,614	112,258,809

* Subject to a deduction of $75,000,000 on account of overvaluations of certain articles received from countries having depreciated currencies.

† The deduction of $75,000,000 from the imports involves an addition of that amount to the excess of exports over imports, raising it to $86,197,133.

Report of the statistician (*Division of Statistics, Report No. 112, n. ser., Jan.–Feb., 1894, pp. 523–590*).—This includes articles on the following subjects: Number and value of farm animals; the cotton crop of 1893; agriculture in China; the sugar crop of the world; Germany

as an importer of American agricultural products; the canning industry (especially tomatoes, corn, and salmon); the crops of Sweden and Norway in 1893; the wheat, rice, and cotton crops of India in 1893; and freight rates of transportation companies.

The following table gives the number and value of farm animals for 1880, 1890, and 1894:

Number and value of farm animals in the United States, 1880, 1890, and 1894.

Animals.	1880.		1890.		1894.	
	Number.	Value.	Number.	Value.	Number.	Value.
Horses	11, 201, 800	$613, 296, 611	14, 213, 837	$978, 516, 562	16, 081, 139	$769, 224, 799
Mules	1, 729. 500	105, 948, 319	2, 331, 027	182, 394, 099	2, 352, 231	146. 232, 811
Cows	12. 027, 000	279, 899, 420	15, 952. 883	352, 152, 133	16, 487, 400	358, 998, 661
Cattle	21. 231, 000	341, 761, 154	36, 849, 924	560, 625, 137	36, 608, 168	536, 789, 747
Sheep	40, 765. 900	90, 230, 537	44, 336, 072	100, 659, 761	45, 048, 017	89, 186, 110
Swine	34, 034, 100	145, 781, 515	51, 602, 780	243, 418, 336	45, 206, 498	270, 384, 626
Total	120, 989, 300	1, 576, 917, 556	165, 285, 623	2, 418, 766, 028	161, 783, 453	2, 170. 816, 754

State laws relating to the management of roads, R. STONE (*Office of Road Inquiry, Bul. No. 1, pp. 95*).—This bulletin embraces a compilation of the most important State laws enacted from 1888 to 1893 on the subject of roads, together with some recommendations made by road commissioners and other public bodies, but not yet acted upon.

I have confined this compilation to laws of recent date, since most of the old laws are confessedly ineffective, and all the practical work of modern road improvement has been and must be done under new statutes. * * * Fourteen States have already passed new roads laws, more or less radical in their character, and nearly all the others are moving in the same direction. * * * The laws given are nearly all of the present year, and they have not fairly gone into use, so that no record of results is available. In New Jersey, however, the new laws date from 1888 to 1892, and have proved so satisfactory in practice that no effort to amend them was made in 1893.

Cranberry culture (*Division of Gardens and Grounds, Farmers' Bul. No. 13, pp. 16*).—A popular bulletin on the cranberry, consisting largely of compilations from articles in the annual reports of the Secretary of Agriculture and from the Handbook of Experiment Station Work. Three kinds of soil are suitable for cranberry culture: (1) "Savannas," or low spots overgrown with grass or small shrubs and covered with water during the winter and spring, becoming dry during the summer; (2) a mixture of sand and muck underlaid at a depth of 6 to 10 inches with sand; and (3) deep muck. The cranberry can not be successfully cultivated on the drift formation, that is, soil formed by glacial action and consisting of rocks not in place.

If the bog intended for cranberry culture consists of sand overlaid by about a foot of turfy peat it is only necessary to subsoil the bog and bring up to the surface about 3 inches of sand. In other cases the whole surface must be covered with sand 4 to 8 inches deep. Arrangements must be made for flooding and draining the bog. The more sand

used the longer the time required for the vines to come into bearing. The vines may be either set out in furrows or spread evenly over the surface of the meadow and covered with about an inch of sand, or after being passed through a straw cutter and chopped into pieces about an inch long these cuttings may be sown broadcast and harrowed in. Hand weeding is preferred to the plow and hoe.

Cranberry cultivators are divided in opinion on the subject of fertilizers.

The following insect enemies of the cranberry are noted: The black-headed worm (*Rhopobota vacciniana*), yellow-headed worm (*Teras vacciniivorana*), fruit worm (*Acrobasis vaccinii*), tip worm (*Cecidomyia vaccinii*), and grasshoppers. Cranberry scald, cranberry gall fungus (*Synchytrium vaccinii*), and moss, which sometimes infests bogs, are discussed.

ABSTRACTS OF REPORTS OF FOREIGN INVESTIGATIONS.

Fat extraction, L. GEBEK (*Landw. Vers. Stat., 43 (1893), No. 3 and 4, pp. 193–206, fig. 1*).—This is a detailed account of investigations, a preliminary report on which was published in *Zeitschrift für angewandte Chemie, 1893, No. 9, pp. 253–255* (E. S. R., vol. IV, p. 854).

The results of experiments on a number of feeding stuffs (oil cakes, flesh meal, corn meal, clover hay, malt sprouts, distillery and diffusion residues, and mixed feeds) indicate that by the use of Spanish earth * in the extraction tube an ether extract was obtained which more truly represents the true fat content of these substances than that obtained by the use of burnt gypsum or bone charcoal.—W. H. B.

Comparative determinations of milk fat by the Soxhlet, Schmidt-Bondzynski, Gottlieb, Gerber, and Demichel methods, GRAFFENBERGER (*Landw. Vers. Stat., 43, No. 3 and 4, pp. 247–252*).—The author compared these five methods on 10 samples of milk, ranging in fat from 0.65 to 6.15 per cent. He uses the results of the Soxhlet aerometric method as the basis for judging of the accuracy of the others, and finds that in a large majority of cases the other methods all give slightly lower results than the Soxhlet. The Schmidt-Bondzynski and Gottlieb methods agreed most closely with the Soxhlet, and are recommended. In the Schmidt-Bondzynski method † 10 c.c. of milk and 10 c.c. of hydrochloric acid of 1.19 specific gravity are heated together in a special apparatus until the casein is dissolved, cooled, and then shaken with ether. The volume of fat is read off and an aliquot (20 c.c.) evaporated and weighed.

In the Gottlieb method 10 c.c. of milk and 1 c.c. of ammonia of 0.96 specific gravity are shaken in a tall calibrated cylinder; then 10 c.c. of alcohol and 25 c.c. of ether are added and shaken; and finally 25 c.c. of petroleum ether. After standing four or five hours the fat layer is read off and an aliquot evaporated.

The Schmidt-Bondzynski is the more rapid of the two methods, as the fat layer can be read off in a half hour.—E. W. A.

Further contribution to the analysis of fish guano, poudrette, and similar substances, M. WEIBULL (*Chem. Ztg., 18 (1894), No. 3,*

* Spanish earth is a chalky substance extensively used for the clarification of wines. That employed in these investigations had the following composition: Water 6.78, loss on ignition 6.82, SiO_2 67.56, Al_2O_3 and Fe_2O_3 11.28, CaO 1.04, MgO 5.67 per cent, besides small amounts of potash, soda, phosphoric acid, and chlorine. All these constituents except lime and magnesia were only sparingly soluble in HCl.

† Landw. Jahrb. der Schweiz, 1889.

pp. 31, 32).—In a former article* the author recommended the application of the Kjeldahl method to the simultaneous determination of phosphoric acid and nitrogen in bone meal, manure, fish guano, and similar materials. The molybdic method was then recommended for the determination of phosphoric acid, but recent investigations by the author and others have shown that the citrate method is equally applicable for that purpose, provided a sufficient amount (about 40 c.c.) of citric acid solution is used.

In the present article a further extension of the method to the determination of lime in cheese, milk, and other foods is recommended, the amount of substance taken for digestion of course being increased. In the analysis of peat dust poudrette the following method was used: One hundred grams of material was ground up with 400 grams of concentrated sulphuric acid; of this mixture 50 grams was weighed out, mixed with copper oxide and treated as usual by the Kjeldahl method. At the end of the digestion the solution was washed into a 250 c.c. flask with pure nitrogen-free water and the flask filled to the mark; 100 c.c. of this solution served for the determination of phosphoric acid and a like amount for that of lime; in the remainder, nitrogen was determined. Only in case of the determination of phosphoric acid by the citrate method was filtration of the solution necessary. The determination of lime and nitrogen was not affected by the presence of small amounts of sand, etc.

To determine the lime the solution was exactly neutralized with ammonia and a few drops of hydrochloric acid added until the reaction was slightly acid. To the hot solution a sufficient amount of ammonium oxalate was added and the mixture allowed to stand two hours at the temperature of the water bath. The determination of the calcium oxalate by titration with permanganate, according to Immendorf, is recommended. Careful tests of this method, under varying conditions and comparisons with other methods, indicated that it was as reliable as those ordinarily employed for the determination of lime. It possesses the further advantages of rapidity and simplicity of manipulation.—W. H. B.

The potato tuber as a reservoir of water for the growing plant, SIKOVSKI (*Anzeig. Akad. Wissensch. Krakau, 1892, p. 114; abs. in Ann. Agron., 19* (*1893*), *No. 11, pp. 558, 559*).—It is generally held that the purpose of the parent tuber is to furnish food for the growing plant. A. Müller observed that after the exhaustion of the food supply the tuber accumulated water for the use of the plant. This observation was verified by the author, who severed the connection between the parent tuber and the growing plant after the latter had made considerable growth. As checks, some plants of the same variety were not disturbed. Treated and normal plants were grown in sand and in garden soil. In garden soil the product of a tuber not severed from the plant was 368 grams of potatoes; the separation was made, June 30, the yield was 339 grams;

* Chem. Ztg., 16 (1892), p. 1689.

where the operation was performed, August 31, the yield was 308 grams. In sand the yield without treatment was 177 grams; from the treatment of June 30, 173 grams; from that of August 31, 166 grams.

In both kinds of soil the parent tubers were heavier at the dates when the separation from the growing plant was made than at the time of planting. This gain in weight consisted of water accumulated during the growth of the plant.—J. F. D.

The lecithin content of some vegetable substances, E. SCHULZE and S. FRANKFURT (*Landw. Vers. Stat., 43, No. 3 and 4, pp. 307–318*).—The extent to which lecithin occurs as a component of the crude fat of a number of crops and feeding stuffs has been recently noticed (E. S. R., vol. V, p. 339). The details of the method of determination, as given in the present article, are as follows: About 10 grams of finely ground material is placed in a paper cartridge and extracted with ether in a Soxhlet extractor. The cartridge is then transferred to an Erlenmeyer flask connected with a return-flow condenser and extracted with 100 c.c. absolute alcohol for an hour, the alcohol being heated to boiling. The extract is filtered off and the residue extracted again with 100 c.c. of alcohol as before, when the second extract is filtered off and the residue washed with alcohol. The ether and alcohol extracts are united and evaporated in a platinum dish. The residue is mixed with soda and saltpeter and charred. The phosphoric acid is then determined by the molybdate method. The amount of magnesium pyrophosphate multiplied by the factor 7.2703 is taken as the lecithin content. The weak point in the method is that it is not known with certainty that no other organic phosphor-containing substances occur in the ether-alcohol extract, although none have thus far been found.

The authors give the lecithin content of a large number of substances. The percentages in some substances not mentioned elsewhere are given below:

Per cent of lecithin in dry matter.

	Per cent.
Yellow corn, kernels	0.25
White corn, kernels	0.28
Buckwheat, seed (shells)	0.47
Sunflower seed (shelled)	0.44
Pumpkin seed (shelled)	0.43
Wheat germ	1.55
Wheat bran	0.54
Sesame cake	0.15, 0.50, and 0.56
Linseed cake	0.10 and 0.25
Peanut cake	0.04 and 0.37
Leaf buds of pear	0.54
Leaf buds of hazel	0.77
Leaf buds of maple	0.65
Young grass	0.45
Young vetch plants	0.86
Mushroom (*Agaricus campestris*)	0.32
Mushroom (*Boletus edulis*)	1.94

Leguminous seeds are much richer in lecithin than the seeds of corn, cereals, or oil-bearing seeds. The presence of lecithin in young growing parts has been previously noticed.—E. W. A.

The chlorine content of rain water, N. PASSERINI (*Bol. Scuola Agr. Scandicci, 1893, No. 1 and 2, pp. 12–22; abs. in Centbl. agr. Chem., 23* (*1894*), *No. 1, p. 1*).—Observations during two years at a place near Florence, where all winds, except those from the northwest, pass over the sea, are reported. The rain gauge was located 75 kilometers (46½ miles) in a straight line from the Ligurian and 107 kilometers (66⅓ miles) from the Adriatic Sea.

The amount of chlorine found in the water varied between 0.168 and 24.177 milligrams per liter. The average amounts found during different seasons in each year were as follows:

Chlorine in rain water in different seasons.

Season.	Chorine per liter.	
	1890.	1891.
	Mg.	*Mg.*
Spring	5.1	3.4
Summer	7.0	4.5
Autumn	6.5	3.6
Winter	8.3	3.2

The direction of the wind exerted no constant influence on the amount of chlorine found in the rain water, although it was, as a rule, greatest when the wind was from the west or south and least when east or southeast. The velocity of the wind was also without influence. The first portions of rainfall were much richer in chlorine than the later portions. The amount of chlorine in the rain water collected over the sea was often very considerable and much greater than in the rain collected in the interior of the peninsula.

At Antignano, near Livorno, 100 feet from the sea and 33 feet above the sea level, rain water was collected during the period from October 26 to 30, 1890, while a southwest wind prevailed. This rain water contained, on an average, 116.77 grams of chlorine per liter. It appears that near the sea the air always contains a considerable amount of chlorine when it has not been recently washed down by rain, and that this amount is greatest when a strong wind is blowing from the direction of the sea.—W. H. B.

The drainage water of cultivated soils, P. P. DEHÉRAIN (*Ann. Agron., 20* (*1894*), *No. 1, pp. 21–42*).—This is a detailed account of observations in continuation of those reported in *Annales Agronomiques*, 19 (1893), pp. 69–89 (E. S. R., vol. IV, p. 682), and relates especially to the composition of the drainage water from the vegetation cases there described during the winter months, although the complete results for the year beginning March, 1892, are tabulated and discussed. It is stated that the losses of nitric nitrogen shown by analysis during this first

year of observation are excessive on account of the thorough aeration and pulverization of the soil during the construction and filling of the cases.*

The figures, therefore, are only of value for purposes of comparison. Studied from this standpoint it appears that—

(1) The losses in the drainage were greatest on fallow soils. Not only was the drainage water more abundant, but it was also richer than that obtained from soils bearing crops.

(2) The losses were reduced to the minimum in soils covered by plants. In fact very little water reached the drains during summer, and frequently, unless violent storms occurred, the drains received no water at all, that received from atmospheric precipitation being returned to the air through the transpiration of the plants. During winter, it is true, the water percolated through the pasture soil as well as that seeded to winter wheat, but since the roots of plants possess the property of retaining the nitrates the losses were reduced to the minimum.

These observations lead to the following interesting practical deductions: The enrichment of permanent pastures in nitrogen is due not only to the fixation of nitrogen by microbic action, but also to the very slight losses sustained by drainage. In an undisturbed soil such as this nitrification is less active and the abundant supply of absorbent roots takes up the nitrates as fast as they are formed.

The rotation which keeps the soil covered the longest is that which most completely prevents loss. The results here reported show that where wheat succeeded sugar beets, the soil being covered continuously from April of one year to August of the succeeding year, the losses were very small. On the other hand, they were quite large in another case during the eight months which intervened between the harvesting of one crop and the planting of another crop of sugar beets. They were very greatly reduced, however, when a fallow crop was planted immediately after the harvesting of the beets.—W. H. B.

Investigations on the influence of the texture of soils on their moisture content, E. WOLLNY (*Forsch. Geb. Agr. Phys., 16 (1893), No. 5, pp. 381–407*).—In this article the author describes the methods used and reviews at length the results obtained, in experiments carried out during a number of years past (1878–'93) on the relation of the size and arrangement of the soil particles to moisture content. The results lead to the following conclusions:

(1) The water content of the soil as a rule increases with the fineness of the soil particles and is considerably greater in a pulverized soil than in one in a crumbly condition, because the reduction of the size of the soil particles by pulverization increases the water capacity of the

* For a report on observations on the relation between pulverization of the soil and the activity of nitrification see *Compt. Rend.*, 116 (1893), pp. 1091–1097 (E. S. R., vol. IV, p. 961).

soil and lessens the downward movement of the water received from the atmosphere.

(2) The soil evaporates larger amounts of water the smaller the particles, because the rise of water by capillarity is promoted and the drying of the surface is lessened. Soils in pulverized condition evaporate more water than those in a crumbly condition, because in the former case the loss by evaporation is more readily supplied from the soil than in the latter.

(3) Percolation increases with the size of the soil particles, because the downward movement of water meets with less opposition and the supply of water to surface evaporation is smaller the larger the soil particles. Soils in a pulverized condition lose by drainage smaller amounts of water than those in crumbly condition, on account of their diminished permeability and higher absorptive power.

(4) The differences in moisture content of soils of different sized particles, as well as of soils in pulverized and crumbly condition are, as a rule, much more marked in wet weather than in dry. In the latter case they may entirely disappear or even be reversed. To explain these facts we must take into consideration the relative activity of evaporation and percolation, as already noted.

(5) The variations of soil moisture increase with the diminution of the diameter of the particles and are greater in pulverized than in crumbly soil, for reasons which have already been explained.

(6) The crumbling of wet clay soils prevents an excess or deficiency of water in the same, because in case of excessive precipitation drainage is promoted and in dry weather evaporation of water from the surface is diminished. For these reasons it appears that the bringing about of a crumbly structure in soils of this kind should be the object sought after in cultivation.—W. H. B.

Fertilizer experiments with phosphoric acid, M. MAERCKER (*Abs. in Königsberger land- und forstw. Ztg.*, *29* (*1893*), *No. 42, p. 277*).—This is an account of fertilizer experiments at the Halle Station during 1892, and relates especially to the need of phosphoric acid in different kinds of soils, the persistency of effect of phosphatic fertilizers, and a comparison of the immediate and after effects of ground Thomas slag and superphosphate.

As in previous years, digestion of soils with citric acid solution was employed with good results as a means of judging of the amount of assimilable phosphoric acid present. Soils having like amounts of phosphoric acid showed wide variations in the solubility of this substance.

These tests in connection with experiments in a vegetation house in growing crops on different kinds of soil showed that the persistency of effect of phosphatic fertilizers was by no means as great as it is generally supposed to be, but that on soils richest in phosphoric acid a diminution of effect was noticeable on the third crop, and on the fifth crop

was very marked. It is doubtful whether all or even the greater part of the excess of phosphoric acid applied to a crop is utilized by the crop following. It appears that the practice of applying excessive amounts of phosphoric acid, as in sugar-beet culture, with the expectation that the after crops will utilize it to advantage is wasteful and inadvisable. These conclusions, reached from experiments during three years in the vegetation house, were confirmed by experiments on a number of farms.

A comparison of the immediate and after effects of ground Thomas slag and superphosphate was made during 1891 and 1892 on summer rye followed by winter rye, in vegetation boxes containing about 5 kg. of dry earth. The two phosphates were applied at rates of 0.75, 1.5, and 3 grams of phosphoric acid per box. The effect of the ground Thomas slag (containing 92 per cent of fine meal) as compared with that of water-soluble phosphoric acid was as 65:100. The yield of straw was the same for the two forms of phosphoric acid, but the production of grain was much larger in the case of the water-soluble phosphoric acid. Applications of double the amount of phosphoric acid in Thomas slag considerably increased the yield, the amount of straw being nearly the same as in case of the double amount of water-soluble phosphoric acid, but the yield of grain was not quite so large as that produced by the single application of water-soluble phosphoric acid. The heaviest application of ground Thomas slag did not produce as large a yield of grain as the smaller applications of water-soluble phosphoric acid. The smaller application of slag proved profitable, but in no amount used did this fertilizer produce a maximum yield. The after effect of the phosphoric acid in ground Thomas slag was much smaller than that in the superphosphate, for while in the first year the ratio of effect of the two was as 65:100, in the second year it was only as from 45 to 51.7:100. It appears therefore that the ground Thomas slag is not only less soluble the first year, but is less readily utilized by the crops of succeeding years.

Experiments on oats in 1892 with two other samples of ground Thomas slag, one very rich and the other very poor in phosphoric acid, confirmed the above results.

The experiments in general show that while small applications of ground Thomas slag were always remunerative, in none of the forms and amounts used did it produce the maximum yield of summer rye, winter rye, or oats; and indicate that the effectiveness of ground Thomas slag in certain cases has been overestimated.—W. H. B.

Cross fertilization of cereals, W. CARRUTHERS (*Jour. Roy. Agr. Soc. England, 4 (1893), No. 4, ser. 3, pp. 684–702, figs. 7*).—The author gives a popular discussion of the conditions for cross fertilizing as a means for the improvement of cereals, and of the results which may be expected The numerous difficulties to be encountered in the crossing of cereals are mentioned and general notes given on the flowers of such plants. The usual methods of pollination are described and especial attention

given to the difficulties presented in the cross-fertilization of wheat. In wheat the stamens ripen their pollen and the stigmas become receptive at nearly the same time and both being borne in the same flower the tendency is to close fertilization. Observations in the field tend to confirm this view, for in experimental plats where different varieties of wheat were grown in close parallel rows no natural crosses were noticed. To cross fertilize wheat requires great skill and patience. The stamens must be removed before the pollen grains are ripe and the stigmas protected from the pollen of other flowers in the same or neighboring spikes. The application of pollen to stigma should be made by drawing the anther containing the ripe pollen grains lightly over the receptive stigma.

In order to secure a cross that will propagate itself it must be made within the same species, as hybrids resulting from crosses of species or genera are seldom fertile the second year. The nearer the affinities of the two parents the more certain will be the successful fertilization. Close fertilization tends to give stronger reproductive organs and cross fertilization tends to strengthen the vegetative parts of the plant. Again, in selecting parents for crossing the male seems to have special influence on the seed, while the female affects the character of the vegetative parts of the plants.

The work of cross breeding must be continued by selection for years after a desired cross is obtained, as there is a constant tendency to reversion and only by selection and elimination of sports and undesirable reversions is a variety finally established.

The record of thirty years' experimentation by Messrs. R. and J. Garton in crossing wheat, barley, and oats is given. Figures are given of the parents and the crosses. Some of the crosses have proved valuable, while others are but curiosities of no especial merit. By continued selection the experimenters hope to secure varieties of cereals especially adapted to their surroundings.—W. H. E.

Investigation of Swedish legu minous plants, L. F. NILSON (*Kgl. Landt. Akad. Handl. Tidskr., 13 (1893), pp. 257–298, 321–355*).—This investigation of wild and cultivated Swedish leguminous plants includes fifty complete analyses of 38 different varieties, including vetches, astragalus, lentils, *Lathyrus*, *Lotus*, alfalfa, melilotus, peas, and clovers.

Information concerning the botanical features and possible economic value of the plants is given in every case. The chemical analysis included determinations of albuminoid and amide nitrogen, as well as of digestible nitrogen (Stutzer's method). The tables of composition show that the species belonging to the genus *Lathyrus* are richest in protein, their content ranging between 19.8 per cent (*L. palustris*) and 26.7 per cent (*L. sylvestris*). The vetches come next in protein content, with upper limit ranging from 14.8 (*Vicia pisiformis*) to 22.3 per cent (*V. sativa*). None of the species of *Trifolium* reach the maximum limit

of these two genera, their protein contents lying between 12.83 per cent (*T. montanum*) and 17.52 per cent (*T. fragiferum*).

The general results of the investigation are summarized by the author as follows:

The investigation shows that several legumes growing wild in Sweden, notably of the genera *Lathyrus*, *Vicia*, and *Medicago*, far surpass in protein content the majority of fodder plants of this family cultivated at the present time, and are not inferior to them in other food constituents. Of the wild varieties which grow well on poor soils, and which certainly may become of great importance for various purposes, the following are worthy of especial mention: *Lathyrus maritimus* is by nature assigned to the quicksand region and *Lathyrus palustris* to lowland meadows; *L. sylvestris* and *Vicia pisiformis* both develop luxuriantly on slaty soils poor in humus; *Medicago falcata*, *M. lupulina*, and *Astragalus alpinus* are all adapted to meadows, the *Astragalus* especially to the higher northern parts of Sweden.

Whether or not it will pay to cultivate certain wild species among those investigated, and to what extent, can of course only be determined by direct experiments. Such culture experiments are often accompanied by difficulties. Seed of these plants is not easily obtained in any quantity, and it has shown but low germinating power on account of the thick seed coats. It is, however, to be hoped that the former difficulty may be removed by the increasing cultivation of these plants, especially since the latter difficulty is already entirely overcome by Hjalmar Nilsson's seed preparer. This will bring the seed to perfect germination without the germ being injured in the least by the breaking of the seed coats in the treatment.

The species of clover now universally cultivated in Sweden has been adapted from the wilderness since the middle of the last century, and we may well entertain hopes that our agriculture may be enriched through the cultivation of several still wild species of leguminous plants which not only quantitatively but qualitatively give rich yields.

The importance of bringing certain of these plants under cultivation will be evident from an example. Assuming that *Lathyrus sylvestris* yields as heavily as red clover, an assumption which may not be considered unwarranted, the hay raised would be of twice the value of red clover hay, as the content of digestible and total nitrogenous substances in the *Lathyrus* hay is twice as large. To this may be added the noteworthy advantage that *Lathyrus sylvestris* is a perennial. With its coarse and deep-reaching roots it leaves the ground even a richer supply of combined nitrogen than red clover does.—F. W. W.

Experiment in feeding barley and skim milk to pigs, J. KLEIN (*Milch Ztg.*, *23* (*1894*), *No. 1*, *pp. 3*, *4*, *and No. 2*, *pp. 19–22*).—This experiment was made at the Dairy Institute at Proskau, Germany, during the summer and fall of 1893. Its main object was to compare the feeding of barley whole, both raw and cooked, and crushed and

ground. Four lots of two pigs each, a sow and a barrow, about three months old at the beginning were used. The pairs were selected after a preliminary trial. The experiment commenced July 24, and the feeding was as follows:

Lot 1, whole barley, raw.
Lot 2, crushed barley, raw.
Lot 3, ground barley, raw.
Lot 4, whole barley, cooked.

All the lots received steamed potatoes and skim milk in addition to the barley. Each kind of food was fed separately, and apparently the raw barley was fed dry. The amount of food given was made to conform to a feeding standard (Rohdes).

From July 24 to October 9, lot 1 gained 65.25 kg., lot 2, 65 kg., and lot 3, 68 kg.; and all ate the same amounts of food. Up to this time, therefore, there was no apparent difference in the effect of the food whether fed whole, ground, or cooked. Lot 2 had to be thrown out, as the barrow did not do well on the crushed barley. The sow of that lot made about the same gain as the other lots. When the barrow was changed to ground barley it made a satisfactory gain.

In the week from October 2 to 9 the amount of food given was $4\frac{1}{2}$ kg. of skim milk, $1\frac{1}{4}$ kg. of barley, and 1 kg. of potatoes per pig daily. The barrow in lot 1 refused to take more whole barley and seemed to have lost his appetite for it, but the sow was increased to 2 kg. per day, and made gains equal to the other lots.

The observations on lots 1 and 2 bring out the element of individuality and show the difference there may be in the effect of the same food on different animals.

October 23 the sow of lot 1 (whole barley) was changed to crushed barley and fed with the sow of lot 2 (crushed barley).

Lots 3 and 4 were fed to December 3 without interruption, the food being gradually increased with the increase in weight. At that time lot 1 had gained 136 kg. and lot 2 130.75 kg. since July 24. The two sows on crushed barley were slaughtered somewhat earlier. There was little or no difference between the effects of crushed and ground barley in nearly four months of feeding. There appeared to be a very slight disadvantage from cooking the whole barley. It is believed that cooking diminished the digestibility. It is stated that lot 3, on ground barley, had the best appetites throughout the trial, appeared and looked the best, and gave the most satisfactory result on slaughtering.

When the barrow from lot 2, fed at first on crushed barley and later on ground barley, was slaughtered the marks of a running sore were found in the rectum, which, it is suggested, may have been caused by a wound made by the feces from the dry crushed barley. This may account for the animal not having done better on crushed barley, as when changed to barley meal it made satisfactory gains.—E. W. A.

Composition and food value of the seed of Chenopodium album, G. BAUMERT and K. HALPERN (*Arch. Pharm., 231 (1893), p. 641; abs. in Chem. Ztg., 18 (1894), No. 2, Repert., p. 7*).—The seed of the lamb's quarters or white goosefoot (pigweed) has at times been used as a substitute for rye, as was the case during the recent famine in Russia. The composition of the seed and the hulls is given as follows:

Composition of seed and hulls of Chenopodium album.

	Seed.	Hulls.
	Per cent.	*Per cent.*
Water	10.33	7.45
Crude protein	13.94	12.25
Albuminoids (in protein)	12.56	9.91
Crude fat	6.97	2.86
Crude fiber	25.68	17.96
Nitrogen-free extract	39.30	39.66
Ash	3.88	19.85

Bread made from a mixture of the above seed with rye or wheat is said to be considerably inferior from a physiological standpoint to common bread.—E. W. A.

Experiments on the digestibility and nutritive value of the grain of various cereals, H. WEISKE (*Landw. Vers. Stat., 43, No. 3 and 4, pp. 207–222*).—The author found in previous experiments with rabbits (E. S. R., vol. IV, p. 598) that the rate of digestibility of oats was in inverse proportion to the amount of oats eaten. To ascertain whether this was true in the case of herbivorous animals, he commenced an experiment with two sheep, feeding 500 grams of oats per head daily. The experiment had to be discontinued at the end of eight days as one sheep refused to eat the full ration of oats. The coefficients of digestibility found, as compared with those found in a former trial with sheep on a larger ration of oats, were as follows:

Coefficients of digestibility for oats fed in different amounts.

	Dry matter.	Crude protein.	Crude fat.	Crude cellulose.	Nitrogen-free extract.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Sheep No. 1, 500 grams oats	79.5	78.4	88.3	52.9	86.4
Sheep No. 2, 500 grams oats	72.6	61.3	85.1	48.3	81.5
In former trial, 947 grams oats	69.8	64.5	58.0	17.2	81.7

No conclusions are drawn from this comparison owing to the wide difference between the coefficients found for protein with the two sheep, which is attributed to individuality. It is suggested that No. 2 may have eaten its food more rapidly and not masticated or rechewed it as thoroughly as No. 1.

Digestion experiments with rabbits are also reported for rye and barley. The average results of these and of former experiments with rabbits on oats are summarized in the following table:

Coefficients of digestibility for oats, barley, and rye obtained with rabbits.

	Dry matter.	Organic matter.	Crude protein.	Crude fat.	Crude fiber.	Nitrogen-free extract.	Crude ash.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Oats	73.7	74.5	80.2	93.8	21.6	79.5	46.4
Barley	84.0	85.4	67.7	86.3	25.1	91.2	51.2
Rye	84.4	85.4	63.0	76.3	18.5	91.2	34.4

According to these figures the protein and fat of the oats are better digested and resorbed than those of either barley or rye, although the reverse is true in the case of the crude fiber and nitrogen-free extract. As is well known, the oat kernel is the richest of all cereals in crude fiber. The oats fed in the above experiments contained 12.3 per cent of crude fiber, while the barley contained only 4.46 per cent and the rye only 2.28 per cent.

The conclusion is that the use of oats for the nourishment of young and weak animals is well founded.—E. W. A.

On the question of feeding raw potatoes, W. VON FUNKE (*Jour. Landw., 41, No. 3, pp. 199–260*).—This article advocates feeding raw potatoes to cattle, milch cows, sheep, and horses. Where the price of potatoes is low, and on farms fitted for raising potatoes, it is stated that they may be utilized to good advantage without cooking, and when rationally fed will have no unfavorable physiological action on the animals. Numerous references are made to the feeding of raw potatoes in practice. For pigs the author believes potatoes should be cooked in order to secure the best result. For fattening cattle he recommends a daily ration of 60 pounds of raw potatoes, 6 pounds of linseed meal, 9 pounds of clover hay, and 36 to 40 grams of salt, per 1,000 pounds live weight. This furnishes 2.84 pounds of protein, 16.75 pounds of carbohydrates, and 0.8 pound of fat, with a nutritive ratio of 1:6.6. The potatoes, linseed meal, and salt are fed together, the potatoes being washed in a potato washer and fed whole. The clover hay is fed alone and uncut.

For milch cows the limit is 25 pounds of potatoes per 1,000 pounds live weight per day, and an equal amount of dry fodder must be fed with them. In some cases it is recommended to mix the potatoes and coarse fodder, moisten, and let the mixture undergo a short spontaneous fermentation. A maximum of 20 pounds of raw potatoes per 1,000 pounds live weight may be fed to work oxen; but potatoes are not fitted for growing cattle under two years old, as they need more concentrated food.

Potatoes are as well fitted for sheep as for cattle and there is little need of preparation further than cutting. The ration per day may range from 25 pounds per 1,000 pounds live weight for yearlings, ewes, and wethers, to 40 pounds for fattening sheep. Potatoes are not considered good for lambs under one year old.

About 12 pounds of raw potatoes per 1,000 pounds live weight may be fed to horses with advantage, and if supplemented with proper food there need be no fear of physiological disturbances. When fed in the amount mentioned they should be mixed with hay or cut straw to insure their being properly chewed. They may be fed whole if small, or sliced if large tubers.

Horses, cattle, and milch cows should not be watered soon after feeding potatoes, but preferably about a half hour before feeding. It is found that the tubers agree with them better under those conditions.

All that the author says concerning the feeding of raw potatoes applies only to healthy, ripe, and unsprouted potatoes.—E. W. A.

Poisoning hogs by feeding ground rye containing cockle seed, STIER (*Berl. Tierärtzl. Wochenschr., Dec. 21, 1893; abs. in Milch Ztg., 23 (1894), No. 1, p. 6*).—The author was called on to treat a herd of swine in which 6 animals had died and 42 others had been attacked, all showing the symptoms of acute poisoning. An examination revealed the fact that in the three days preceding the outbreak the food consisted of potatoes, skim milk, and about 1½ kg. of coarsely ground rye tailings per day and per head. This latter contained at least 6 per cent of cockle, either cracked or whole

In the same stable there was another lot of 200 breeding swine which together had consumed only 12½ kg. of the same rye tailings; none of these animals were attacked. Six others received about 2 kg. of tailings per day, and of these all were attacked and 2 died. Within three days after the last feed of tailings, 13 deaths occurred.

The treatment consisted of a change of diet and the use of castor oil, followed by ether and liquid acetate of iron.

Forty work horses, each of which was fed daily 1½ kg. of similar tailings, were not injured by this feed. In previous years this material had been used as food for hogs without causing any deaths.—J. F. D.

Determination of fat in the milk of individual cows, L. HANSEN (*Ugeskr. f. Landmänd, 39 (1894), pp. 29, 30*).—The paper gives an extract from the tests of the individual cows in herds belonging to patrons of the Kildebrönde creamery in Denmark. The period covered is one year, beginning November 1, 1892. The following table shows the data obtained for the best and the poorest cow as shown by the test:

Yield of milk and butter per cow.

Cow.	Yield per year.		Milk required to make 1 pound of butter.	Value of butter and skim milk.	Cost of food eaten.			Cost of producing 1 pound of butter.
	Milk.	Butter.			Concentrated feed.	Coarse feed.	Total.	
	Pounds.	*Pounds.*	*Pounds.*					*Cents.*
No. 67	8,623	387.4	22.2	$118.76	$25.95	$27.33	$53.27	15.1
No. 36	3,715	128.8	28.7	41.91	22.96	28.30	51.26	43.8

The largest annual yields per cow were 8,877 pounds of milk and 387.4 pounds of butter, and the smallest yields were those given in the above table. To make 1 pound of butter required 21.1 pounds of the richest milk or 32.1 pounds of the poorest milk.—F. W. W.

The relation of the phosphates and casein of milk to lactic fermentation, H. TIMPE (*Landw. Vers. Stat., 43, No. 3 and 4, pp. 223–238*).—A preliminary account of studies on this question has already been noticed (E. S. R., vol. V, p. 247). It has been shown that, although only a trace of lactic acid is formed in a pure solution of milk sugar, as high as 1.6 per cent of acid may be produced in souring milk. After much speculation as to the reason of this, Kabrhel* suggested that the acid formed in souring milk might enter into combination with the casein, and the supposed ill effects of the free acid on the organisms thus be prevented. According to the author, Kabrhel failed to prove this, however, and Timpe himself claims priority in having demonstrated that casein is capable of combining with the acid and that the polybasic phosphates serve merely to neutralize the acid produced. He found in his experiments that acid was not produced in a solution of milk sugar, even when carbonate of lime was present to neutralize the acid formed; but that when milk ash neutralized with ammonia was added the fermentation of the milk sugar went on although it did not when the milk ash was neutralized with sodium hydrate. This showed that the casein was not essential to the growth of the lactic organisms but that ammonia salts could serve the purpose. It was found that in a solution of pure milk sugar and ammonium chloride, with nothing to neutralize the acid formed, an acidity of 0.04 per cent resulted after eight days. When different amounts of dipotassium phosphate were added to the solution there was a relation apparent between the acid produced and the quantity of phosphate added.

In another series of experiments in which five different amounts of a prepared casein were added to the solution of milk sugar and ammonium chloride, the amount of acid produced in eight days was exactly proportional to the casein added. The amounts of alkali required to neutralize the solutions after making allowance for the amounts required by the casein itself corresponded quite closely to the amounts required by the casein itself; that is, the amount of alkali required to neutralize the solution (casein and acid) after the fermentation was approximately twice that required by the casein alone before the fermentation. Consequently the author concludes that the casein enters into a chemical combination with the acid formed, and that the acid thus combined is equivalent to the alkali required to neutralize the casein itself. This ability to form acid-reacting compounds with lactic acid he finds to be shared by peptone as well as by casein. It is, then, through the combined action of the phosphates and the casein in fixing the lactic acid produced, both by giving up alkali and by direct neutralization,

*Allg. Wiener med. Ztg., 1889, Nos. 52 and 53.

that the relatively high percentage of lactic acid found in sour milk is attained. The author figures this out from the average composition of milk.

In view of the fact demonstrated above that the amount of lactic acid formed is materially affected by the polybasic phosphates, the question suggests itself, Do these polybasic phosphates affect the stage of fermentation at which the milk curdles? Hammarsten* found that casein could dissolve neutral calcium phosphate. This is believed to be effected by the casein combining with a part of the base of the phosphate, thus rendering both compounds soluble, which supposes a greater affinity for the lime on the part of the casein than on the part of the monobasic phosphate. Applying this to the fermentation of milk, all the phosphate must be reduced to monobasic phosphate before the casein will be robbed of its alkali by the acid formed and its precipitation effected. Experiments made by the author lead him to believe that this is the case. Hence he concludes that the stage at which curdling takes place is influenced by the amount of polybasic phosphates, and that the casein is not precipitated until all of the phosphates are changed to monobasic salts.—E. W. A.

The proximate composition of butter, H. D. RICHMOND (*Analyst, 1894, Jan., pp. 16–18*).—The percentages of water found in 560 samples of butter are summarized. The analyses were made during a number of years past, by Dr. Vieth and the author, at the laboratory of the Aylesbury Dairy Company, London. The samples included 146 of English butter and 417 of foreign butter—French, Danish, Swedish, Kiel, and Australian. Of the 560 samples, 469, or nearly 84 per cent, contained between 11 and 15 per cent of water; 26 contained a higher percentage of water and 65 a lower percentage.

"Dr. Vieth has expressed the opinion that 16 per cent of water should be considered as the maximum allowable in butter, and, considering the above tables, I can only give my heartiest approval of this view. Out of the whole 560 samples, but 5 contained more than 16 per cent of water. One of these, a Swedish butter, contained a great excess of curd, and had a cheesy taste, evidently from this fact alone a very carelessly made butter. Another sample, the only English one above 16 per cent (containing 16.49 per cent), was churned at a very high temperature. Of the other 3 samples, 1 was a Danish butter and the other 2 Kiel butter. In my opinion the adoption of 16 per cent as the highest permissible limit will inflict no hardship on honest trades, * * * while the adoption of higher limits will but open the way to fraudulent addition of water."—E. W. A.

Studies on the rancidity of the market butter of Halle, SIGISMUND (*Inaugural Dissertation, Halle; abs. in Molk. Ztg., 8 (1894) No. 1, p. 3*).—Investigations of the market milk of Halle had shown it to contain

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* Jahresber. Tier. Chem., 1874, p. 135.

considerable quantities of impurities or dirt, and this led the author to suspect that the quality of the butter might be bad, since such careless handling of the milk would be likely to result in inferior butter. He based his judgment on the free fatty acids, or, in other words, on the degree of rancidity. This he determined as follows: Five to 10 grams of butter was dissolved in a mixture of 20 c.c. of ether and 10 c.c. of alcohol, 1 c.c. of phenolphthalien added, and the solution titrated with decinormal potash solution. The result was corrected for the amount of potash required by the alcohol and ether mixture, and from this is calculated the acidity, or the number of cubic centimeters of normal alkili required to neutralize 100 grams of butter. This gives the rancidity, 1 c.c. of normal alkali for 100 grams of butter being denoted as 1 degree of rancidity. Butter of 8 degrees of rancidity is not considered good butter.

He examined by this method 36 samples of butter from various sources, and found the degree of rancidity to vary from 0.55 to 46.6, averaging 8.66. Nine samples had a higher degree of rancidity than the average.

The author finds that bacteria are to a large extent responsible for the butter becoming rancid. He cites experiments by others showing that bacteria can not thrive in pure fat, and intimates that the impurities in the butter favor its becoming rancid.—E. W. A.

Butter from goats' milk, E. GUTZEIT (*Milch Ztg.*, *22* (*1893*), *No. 46*, *p. 756*).—In the north of Sweden and in some parts of Germany goats' milk is often creamed and made into butter. A sample of goats' butter sent the author from Sweden was found to contain 8.2 per cent of water, 86.5 per cent of fat, 3.9 per cent of salt and ash, and 0.9 per cent of casein. The butter was of a whitish yellow color, hard, and of a rancid taste. The low percentage of water and the relatively high percentage of casein are noticeable. The specific gravity of the fat was 1.8652, the melting point 35.4° C., the volatile fatty acids 25.2, and the iodine number 26.7.—E. W. A.

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On the carbohydrates contained in vegetable cell membranes (*Zur Kenntniss der in den pflanzlichen Zellmembranen enthaltenen Kohlenhydrate*), E. SCHULZE.—*Landw. Jahrb., 23 (1894), No. 1, pp. 1–26.*

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A critical review of chemical studies on cellulose substances (*Les celluloses*).—*Ann. Inst. Pasteur, 7 (1893), No. 11, pp. 786–792.*

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An improvement in Richmond's milk scale, C. E. CASSAL and B. H. GERRANS.—*Analyst, 1894, Feb., pp. 37, 38.*

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Further remarks on the use of acid potassium tartrate for titrating normal solutions (*Nochmals über die Anwendung des Weinsteins für die Stellung der Normallaugen*), A. BORNTRÄGER.—*Ztschr. angew. Chem., 1894, No. 2, pp. 54, 55.*

On the use of ammoniacal cyanide of mercury in quantitative analysis (*Ueber die Anwendung von ammoniakalischem Quecksilbercyanid in der quantitativen Analyse*), F. W. SCHMIDT.—*Ber. deut. chem. Ges., 27 (1894), No. 2, pp. 225–238.*

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The feeding value of leaves (*Der Nährwerth des Baumlaubes*), F. LEHMANN.—*Ztschr. landw. Ver. Hessen, 1894, No. 5, pp. 42, 43.*

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Experiments in replacing the coarse fodder with prepared pulverized wood and sawdust (*Versuche über den Ersatz der Rauhfutterarten durch präpariertes Holzmehl und Sägespäne*), O. KELLNER *et al.*—*Sächs. landw. Ztschr., 1894, No. 1, pp. 2–8.*

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Experiments on the utilization of sweet skim milk by feeding it to lambs (*Versuch über Verwertung von süsser Magermilch durch Lämmermast*), BACKHAUS.—*Jour. Landw., 41, No. 4, pp. 320–328.*

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VETERINARY SCIENCE AND PRACTICE.

Contagious foot and mouth disease in Skaane (Sweden) during 1892–'93 (*Smittosam mul- och klöfsjuka i Skaane under aaren 1892–'93*), E. SCHAUG.—*Kgl. Landt. Akad. Handl. Tidskr., 32 (1893), pp. 376–380.*

Contagious diseases of cattle and swine (*Smittosamma sjukdomar hos nötkreatur och svin*), J. WETTERWIK.—*Nord. Mejerie Tidn., 9 (1894), pp. 4–6, 15, 16.*

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Concerning the antiseptic value of ozone (*Sur la valeur antiseptique de l'ozone*), J. DE CHRISTMAS.—*Ann. Inst. Pasteur, 7 (1893), No. 11, pp. 776–780.*

The effect of glauber salts on the udder and on the milk of cows (*Ueber die Wirkung des Glaubersalzes auf die Beschaffenheit des Euters und der Milch beim Rindvieh*), E. HESS, F. SCHAFFER, and M. LANG.—*Landw. Jahrb. Schweiz, 7 (1893), pp. 210–228.*

A contribution to the knowledge of the danger of tuberculous infection by means of ordinary milk (*Contribution à la question de l'infection tuberculeuse par le*

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Report on the sanitary condition of domestic animals in Belgium in 1892 (*Rapport sur l'état sanitaire des animaux domestiques en 1892*), L. STUBBLE.—*Bul. Min. Agr. Belgique, 9 (1893), No. 5, pp. 149–249.*

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The milk records of American cows (*Milchergiebigkeit amerikanischer Kühe und Produktionskosten der Milch in Amerika*), J. H. VOGEL.—*Deut. landw. Presse, 21 (1894), No. 6, pp. 43, 44.*

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The effect of peanut cake, palm-nut cake, and cotton-seed cake on the fat content of milk (*Die Beeinflussung des Fettgehaltes der Milch durch verschiedene Kraftfuttermittel*), BACKHAUS.—*Jour. Landw., 41, No. 4, pp. 328–332.*

Swedish butter exhibitions (*Svenska smorprofning arne*).—*Tidskr. f. Landtmän, 15 (1894), pp. 29–35; Nord. Mejerie Tidn., 9 (1894), pp. 28, 29.*

The water content of butter (*Untersuchungen betreffs des Wassergehalts der Butter*), W. HOFMEISTER.—*Abs. in Milch-Ztg., 23 (1894), No. 4, p. 51.*

The new methods for determining fat in milk and their importance in dairying (*Ueber die neuern Methoden zur Bestimmung des Fettgehaltes der Milch und die Bedeutung derselben für die Praxis des Molkereiwesens*), E. SCHULZE.—*Landw. Jahrb. Schweiz, 7 (1893), pp. 62–71, figs. 8.*

The employment of the eudiometric method in testing milk, rennet, and water for cheese-making (*Die Anwendung der eudiometrischen Methode zur Untersuchung von Milch, Lab, und Wasser zu Käsereizwecken*), F. SCHAFFER.—*Landw. Jahrb. Schweiz, 7 (1893), pp. 72–80, fig. 1.*

On the manufacture of cheese in Switzerland and Holland (*Om osttilverkningen i Schweiz och Holland*), A. FRIÏS.—*Nord. Mejerie Tidn., 9 (1894), pp. 17, 18, 30, 32.*

Experiments in the prevention of excessively porous cheese (*Ueber einige Versuche, die Blähung der Käse zu verhindern*), E. VON FREUDENREICH.—*Landw. Jahrb. Schweiz, 7 (1893), pp. 81–87, figs. 4.*

Manufacture of condensed milk as a proposed colonial industry, E. C. WOOD.—*Agr. Gaz. N. S. Wales, 6 (1893), No. 12, pp. 921–928.*

Studies on Oidium lactis (*Ueber Oidium lactis*), M. LAND and E. VON FREUDENREICH.—*Landw. Jahrb. Schweiz, 7 (1893), pp. 229–237.*

Results of the inoculation of milch cows with cultures of the bacillus of diphtheria (*Résultats de l'inoculation de vaches laitières avec des cultures de bacille de la diptherie*), A. C. ABBOTT.—*Jour. Path.; abs. in Ann. Inst. Pasteur, 7 (1893), No. 11, pp. 794–798.*

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Vinegar, E. COLLENS.—*Analyst, 1894, Feb., pp. 33–36.*

The ratio between glycerine and alcohol in natural wines (*Ueber das Verhältniss zwischen Glycerin and Alkohol in Naturweinen*), A. BORNTRÄGER.—*Ztschr. angew. Chem., 1894, No. 1, pp. 13, 14.*

Report of wine culture congress held at Montpellier, June 12–15, 1893. I. Phylloxera and American grapes. II. Grape diseases (*Aus dem letzten Weinbau-Kongress in Montpellier*)—*Abs. in Ztschr. Pflanzenkrank., 4 (1894), No. 1, pp. 47–55.*

Statistics of the wine and cider production of France and Algeria (*Production des vins et des cidres en 1892*).—*Jour. Agr. Prat., 57 (1893), No. 49, pp. 804-808.*

EXPERIMENT STATION NOTES.

Alabama Canebrake Station.—J. A. Stuart, veterinarian of the station, has resigned and J. F. Connor, D. V. M., has been elected to fill the vacancy.

Purdue School of Agriculture.—The second annual excursion of students in live stock husbandry at the school occurred early in March and occupied about a week. The route lay south through Indiana to Lexington, Ky., and from there to Richmond, Va., then back to Lafayette, Ind. It included visits to the farms of famous breeders of horses, cattle, and sheep, and incidentally to a number of places of historic interest. The party was personally conducted by Prof. C. S. Plumb. Last year the excursion was a great educational success, and fully as much was expected this year.

Maine Station.—W. Balentine, professor of agriculture in the college and agriculturist to the station, died February 26.

South Carolina Station.—W. L. McGee, assistant director of the Mississippi Station, has been elected agriculturist to this station, vice J. S. Newman, resigned; and J. N. Hook has been elected secretary of the board of control.

Wyoming Station.—F. J. Niswander, entomologist of the station, has prepared an exchange list of Wyoming Coleoptera which will be sent to any one desiring to exchange.

The Climate of Louisiana.—The climatic conditions of north and south Louisiana and their adaptability to the staple crops, cotton and sugar cane, are briefly discussed by R. E. Kerkham in the *American Meteorological Journal for February, 1894 (pp. 430–432)*, on the basis of data collected by the State weather service during the past six years.

Certain Climatic Features of Maryland.—In *American Meteorological Journal for February, 1894 (pp. 420–423)*, W. B. Clark calls attention to the remarkably diversified physiographic features of Maryland, and shows from tabulations of all obtainable records of temperature and precipitation the "very intimate connection between the leading features of the climate and topography of the State."

The chemical and physical investigation of soils.—This is the title of a paper by E. W. Hilgard, read before the World's Congress of Chemists at Chicago, and published in the *Journal of the American Chemical Society, Jan., 1893 (pp. 34–47)*. The author summarizes his views on the value of chemical and physical soil examination from a practical standpoint, and discusses methods used and results obtained, especially upon virgin soils.

"There is one invariable rule as regards plant food percentages to which in virgin soils I fail to find a single exception. It is that all having high percentages are highly productive, unless physical conditions render them uncultivatable.

"The reverse is by no means generally true, for there are soils having what must be considered very low percentages that nevertheless prove both immediately productive and of considerable durability."

The soils of this last class are, however, almost invariably coarse sandy ones. In order that they may be thrifty, it is necessary that the ratios of the several plant food ingredients among themselves should not fall below certain values. Investi-

gation of these ratios has shown that "the substance which assumes commanding importance is lime."

"The most general expression I can give to the results of my discussion of the analyses of virgin soils with respect to lime is that in its presence (in adequate proportions) much smaller percentages of the other plant foods will suffice for high and lasting productiveness; and that much less lime suffices to produce this effect in 'light' than in 'heavy' soils. It thus appears, then, that the question of the adequacy of plant-food percentages is largely dependent upon the proportion of lime, as well as upon the physical character of the soil."

The presence or absence of adequate amounts of lime in soils is readily recognizable by vegetation. Upon the presence of "lime plants" experienced frontiersmen and land experts base their successful locations of good land.

"That 'a limestone country is a rich country' is an old adage, easily verified by any one who observes the geological map as he travels. But the adage holds true not only of limestone districts, but also of those which from other causes have a notable proportion of lime in their soils. The most striking example of the latter class is the entire arid region of America, as well as of Asia and Africa."*

PRIZE FOR BOTANICAL MONOGRAPH.—The competition for the prize of 500 francs, founded by DeCandolle for the best monograph on a genus or family of plants, has been opened by the *Societé de Physique et d'Historie Naturelle,* of Geneva. The memoirs may be written in Latin, French, German, English, or Italian, and should be sent to the president of the society before January 15, 1895. Members of the society can not compete.

GERMINATION TESTS OF TOBACCO SEED.—A germination test made of seed of 12 varieties of tobacco from the United States and of 4 Australian varieties is recorded in *Agricultural Gazette of New South Wales, 6 (1893), No. 12, pp. 946, 947.* The percentages of germination were as follows: Big Frederic, 89; Connecticut, 63; De Hongrie Debroe, 67; Fly River, 63; Havanna, 16; Hester, 17; Hyco, 22; Maryland, 61; Orinoco, 6; Primus, 88; Sterling, 23; Tuckahoe, 9; Virginia, 79; White Burley, 47; Yellow Prior, 14; and Yenidjek, 56; an average of 45 per cent for all varieties tested. The germination period ranged from five days for Primus to eleven days for Orinoco.

COOKING FOOD FOR CATTLE.—In *Molkerei Zeitung* (*7* (*1893*), *No. 42, p. 578*), B. Rost summarizes the advantages of cooking food for cattle. He found that cooking gave an increase in milk production; increased the palatability of the food; induced cattle in cold weather to take more water into their systems than when dry feed and cold water were relied on; and saved the food, which would otherwise be consumed in raising the food to the temperature of the animal body. To avoid injury to the animals' health he recommends that not over one fifth of the total food be cooked, and that food should never be offered when warmer than 31.2° to 37.5° C. In portions of Germany cooked food is largely used for heifers, cows, and oxen, and the result is entirely satisfactory.

POISONING CALVES BY FEEDING COTTON-SEED MEAL.—In *Milch Ztg., 23* (*1894*), *No. 3, pp. 38, 39,* there is a note on the injurious effect of feeding large quantities of cotton-seed meal to calves. In the summer of 1893 Tietze investigated several cases in which the death of calves aged 9 to 12 months was attributable to the use of cotton-seed meal. These calves received 3 heaping liters (more than 3 quarts) of cotton-seed meal daily in addition to skim milk, hay, and linseed cake. About ten days before death symptoms of disease were noticed.

A NEW METHOD OF CHURNING.—In *La Laitiere* (*1893, No. 12*) Dr. U. W. Massalsky proposes to mix the separator cream with an equal amount of water at 60° to 70° C., or with five or six times this amount of water, run the mixture through the separator again, and then churn the cream thus separated. It is claimed that in this way a purer fat is obtained, nearly free from casein and other fat-free materials. As a result the butter is more quickly churned and keeps longer. About twenty minutes

*See U. S. Weather Bureau, Bulletin No. 3; E. S. R., vol. IV, p. 276.

was required for the churning at 17° C. No data are given as to the loss of fat by this method of treatment or the percentage of water in the butter. A series of trials of the method, controlled by analysis of the products, would be of interest.

THE RUSSIAN MINISTRY OF AGRICULTURE.—Following the example of western Europe and the United States, the Russian Ministry of Agriculture is organizing special bureaus in the interest of rural economy. These are to be attached to the scientific committee of the ministry, and include the following bureaus: Agronomy, botany, zoölogy and zoötechnics, bacteriology, entomology, meteorology, farming, mechanics, and forestry, and a bureau for the study of the soil. A specialist will be placed at the head of each bureau. The scientific committee of the ministry will be divided into two sections—rural economy and forestry. Representatives of the Imperial Institute of Experimental Medicine will be invited to investigate measures for combating harmful insects and vegetable parasites. The hard lesson of the famine is bringing forth good results, and great efforts are being made by the Government to improve in every way practicable the condition of farming and rural economy in Russia.

RECENT ARTICLES BY STATION WORKERS.—*American Agriculturist for February, 1894:* Fungi on weeds, B. D. Halsted; Raising figs from seed, F. W. Massey; The curl of the peach, L. R. Taft.

Torrey Bulletin (vol. XXI): Club root in common weeds, B. D. Halsted, pp. 76–78, figs. 2; Heliotropism in *Cassia marylandica*, G. F. Atkinson, p. 81.

Garden and Forest (vol. VII): Wire netting for peas, H. M. Beckwith, pp. 88, 89.

Agriculture of Pennsylvania: Agricultural experiment stations, H. P. Armsby, pp. 124–131; Peach yellows, G. C. Butz, pp. 132–137.

Second Biennial Report of the Oregon State Board of Horticulture, 1893: The soils of Oregon, G. W. Shaw; Some fungus foes, and Floriculture, E. R. Lake; Drainage, J. M. Bloss. J. H. Comstock contributes a paper on How to fight insect pests.

PERSONAL MENTION.—Dr. W. Migula has been appointed professor of botany at Karlsruhe Technical High School, Dr. W. Laposchnikoff, professor of botany in Tomsk University, Siberia, and Dr. Zelinka, extraordinary professor of zoölogy in Graz University.

LIST OF PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE.

MARCH, 1894.

Farmers' Bulletin, No. 14.—Fertilizers for Cotton.

DIVISION OF CHEMISTRY:

Bulletin No. 39.—Experiments with Sugar Beets in 1893.

WEATHER BUREAU:

Monthly Weather Review, January, 1894.

Bulletin No. 11.—Report of the International Meteorological Congress at Chicago, August 21–24, 1893, part I.

Bulletin B.—Currents of the Great Lakes as Deduced from the Movements of Bottle Papers During the Seasons of 1892 and 1893.

OFFICE OF EXPERIMENT STATIONS:

Experiment Station Record, vol. V, Nos. 6 and 7.

Bulletin No. 19.—Organization Lists of the Agricultural Experiment Stations and Agricultural Schools and Colleges in the United States.

OFFICE OF ROAD INQUIRY:

Bulletin No. 2.—Proceedings of the Minnesota Good Roads Convention at St. Paul, Minnesota, January 25, 26, 1894.

LIST OF STATION PUBLICATIONS RECEIVED BY THE OFFICE OF EXPERIMENT STATIONS.

MARCH, 1894.

AGRICULTURAL EXPERIMENT STATION OF THE AGRICULTURAL AND MECHANICAL COLLEGE OF ALABAMA:

Bulletin No. 53, January, 1894.—A New Milk or Water Sterilizer.

Bulletin No. 54, February, 1894.—Tobacco.

AGRICULTURAL EXPERIMENT STATION OF THE UNIVERSITY OF ARIZONA:

Bulletin No. 9, November, 1893.—Insects and Insecticides.

Bulletin No. 10, December, 1893.—Experimental Work at Willcox.

ARKANSAS AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 25, December, 1893.—Unsound Corn and Forage as a Cause of Disease in Live Stock; Colic in Horses and Mules; Some Further Experiments with Texas Cattle Fever.

COLORADO AGRICULTURAL EXPERIMENT STATION:

Sixth Annual Report, 1893.

THE CONNECTICUT AGRICULTURAL EXPERIMENT STATION:

Seventeenth Annual Report, 1893.—Parts II and III.

STORRS AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 10, March, 1893.—Results of Experiments with Fertilizers on Different Classes of Soils.

Bulletin No. 11, April, 1893.—Summary of Annual Report for 1892.

Bulletin No. 12, February, 1894.—The Ripening of Cream by Artificial Bacteria Cultures.

THE DELAWARE COLLEGE AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 23, March, 1894.—Texas Fever.

AGRICULTURAL EXPERIMENT STATION OF THE UNIVERSITY OF IDAHO:

Bulletin No. 5, October, 1893.—The Relation of Meteorology to the Agricultural Interests of Idaho.

Bulletin No. 6, January, 1894. (Annual Report, 1893.)

AGRICULTURAL EXPERIMENT STATION OF INDIANA:

Bulletin No. 48, January, 1894.—Experiments with Small Fruits.

Bulletin No. 49, March, 1894.—Sugar Beets.

IOWA AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 22, 1893.—A Study in Churning; Composite Samples at the Creamery; Chromate Preservatives; Rennet Extracts; Sand Cherries for Stocks; Rose Hybrids.

Bulletin No. 23, 1893.—Soiling; A Study of Ripening Corn; Injurious Insects; Crossing Cucurbits; Fungus Diseases; Sugar Beets; Rainfall Record.

LOUISIANA AGRICULTURAL EXPERIMENT STATIONS:

Sixth Annual Report, 1893.

Bulletin No. 24, February, 1894.—Sugar Cane.

MAINE STATE COLLEGE AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 5, January, 1894.—Waste of Fat in Skimmed Milk by the Deep-setting Process.

Bulletin No. 6, January, 1894.—Fruit Culture.

MARYLAND AGRICULTURAL EXPERIMENT STATION:

Sixth Annual Report, 1893.

Bulletin No. 24, February, 1894.—Composition of Commercial Fertilizers Sold in the State.

Bulletin No. 25, March, 1894.—Agricultural and Horticultural Departments.

MASSACHUSETTS STATE AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 51, March, 1894.—Commercial Fertilizers; Analyses of Fodder Articles.

HATCH EXPERIMENT STATION OF THE MASSACHUSETTS AGRICULTURAL COLLEGE:

Meteorological Bulletin No. 62, February, 1894.

MISSOURI AGRICULTURAL COLLEGE EXPERIMENT STATION:

Bulletin No. 19, October, 1892.—Soils and Fertilizers.

Bulletin No. 22, July, 1893.—Seedling Strawberries.

AGRICULTURAL EXPERIMENT STATION OF NEW MEXICO:

Bulletin No. 12, November, 1893.—The Value of Rio Grande Water for Irrigation.

NEW YORK AGRICULTURAL EXPERIMENT STATION:

Eleventh Annual Report, 1892.

Bulletin No. 66 (new series), January, 1894.—Analyses of Commercial Fertilizers Collected in the Fall of 1893.

Bulletin No. 67 (new series), February, 1894.—Experiments in Preventing Pear Scab in 1893.

Bulletin No. 68 (new series), March, 1894.—Investigations Relating to the Manufacture of Cheese, part V.

CORNELL UNIVERSITY AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 62, January, 1894.—The Japanese Plums in North America.

Bulletin No. 63, March, 1894.—Coöperative Test of Sugar Beets.

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Bulletin No. 95, January, 1894.—The Fertilizer Control during 1893.

Bulletin No. 97, January, 1894.—Digestion Experiments.

Special Bulletin No. 16, February, 1894.—Fertilizer Analyses and the Fertilizer Control.

Special Bulletin No. 17, March, 1894.—Fertilizer Analyses and the Fertilizer Control.

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Bulletin No. 12, January, 1894.—Transplanting Onions.

Ohio Agricultural Experiment Station:

Bulletin No. 50, November, 1893.—Experiments in Feeding for Milk.

Oklahoma Agricultural Experiment Station:

Bulletin No. 7, July, 1893.—Water Analyses.

Bulletin No. 9, January, 1894.—Test of Varieties of Vegetables, 1893.

Bulletin No. 10, April, 1894.—Corn.

Oregon Experiment Station:

Bulletin No. 27, December, 1893.—Plant Diseases: Their Cause and Prevention.

Bulletin No. 28, January, 1894.—Continuation of Experiments in Pig Feeding.

The Pennsylvania State College Agricultural Experiment Station:

Annual Report, 1892.

South Carolina Agricultural Experiment Station:

Sixth Annual Financial Report, 1893.

Bulletin No. 9, March, 1893.—Experiments with Irish Potatoes.

Bulletin No. 10, April, 1893.—Notes on Varieties of Beans.

Bulletin No. 11, April, 1893.—Analyses of Commercial Fertilizers, part I.

Bulletin No. 12, May, 1893.—Coöperative Soil Tests of Fertilizers.

South Carolina Agricultural Experiment Station—Continued.

Bulletin No. 13, July, 1893.—Analyses of Commercial Fertilizers, part II.

Bulletin No. 14, August, 1893.—Experiments with Corn.

Bulletin No. 15, March, 1894.—Fertilizer Experiments with Corn.

Tennessee Agricultural Experiment Station:

Sixth Annual Report, 1893.

Vermont Agricultural Experiment Station:

Bulletin No. 40, December, 1893.—Spraying Potatoes.

Virginia Agricultural and Mechanical College Experiment Station:

Bulletin No. 30, July, 1893.—Grape Culture.

Bulletin No. 31, August, 1893.—Tests for Fertilizers on Corn.

West Virginia Agricultural Experiment Station:

Bulletin No. 34, December, 1893.—Fertilizer Analyses for 1893.

Bulletin No. 35, January, 1894.—Defects in Wood Caused by Insects.

Bulletin No. 36, February, 1894.—Black Holes in Wood.

DOMINION OF CANADA.

Department of Agriculture:

Bulletin No. 20, February, 1894.—Tuberculosis.

Ontario Agricultural College Experiment Station:

Nineteenth Annual Report, 1893.

PUBLICATIONS OF THE OFFICE OF EXPERIMENT STATIONS

The Office of Experiment Stations issues three classes of publications for general distribution:

(1) Experiment Station Record and (2) Bulletins, which are more or less technical. It is the practice to send to persons applying for them one or more numbers, from which they may judge of their usefulness, but not to place any names upon the mailing list until after receipt of applications on special blanks furnished by the Office.

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The following publications have been issued:

Experiment Station Record, vol. I, 6 numbers; vol. II, 12 numbers; vol. III, 12 numbers and index; vol. IV, 12 numbers including index; vol. V, Nos. 1–7. Copies of the Station and Department publications abstracted in the Record can, in many instances, be obtained on application.

Bulletins.—No. 1, Organization and History of the Stations; No. 2, Digest of Annual Reports of the Stations for 1888, in two parts; No. 3, Report of Meeting of Horticulturists at Columbus, Ohio, June, 1889; No. 4, List of Station Horticulturists and Outline of their Work; No. 5, Organization Lists of Stations and Colleges, March, 1890; No. 6, List of Station Botanists and Outline of their Work; No. 7, Proceedings of the Fifth Annual Convention of the Association of American Agricultural Colleges and Experiment Stations, Washington, D. C., August, 1891; No. 8, Lectures on Investigations at Rothamsted Experimental Station; No. 9, The Fermentations of Milk; No. 10, Meteorological Work for Agricultural Institutions; No. 11, A Compilation of Analyses of American Feeding Stuffs; No. 12, Organization Lists of the Agricultural Experiment Stations and Agricultural Schools and Colleges in the United States, June, 1892; No. 13, Organization Lists of the Agricultural Experiment Stations and Agricultural Schools and Colleges in the United States, April, 1893; No. 14, Proceedings of a Convention of the National League for Good Roads, January, 1893; No. 15, Handbook of Experiment Station Work; No. 16, Proceedings of the Sixth Annual Convention of the Association of American Agricultural Colleges and Experiment Stations, New Orleans, Louisiana, November, 1892; No. 17, Suggestions for the Establishment of Food Laboratories; No. 18, Assimilation of Free Atmospheric Nitrogen by White and Black Mustard; No. 19, Organization Lists of the Agricultural Experiment Stations and Agricultural Schools and Colleges in the United States, January, 1894.

Miscellaneous Bulletins.—No. 1, Proceedings of Knoxville Convention of Association of Agricultural Colleges and Stations, January, 1889; No. 2, Proceedings of Washington Convention of the Association, November, 1889; No. 3, Proceedings of Champaign Convention of the Association, November, 1890. (Series discontinued.)

Farmers' Bulletins.—No. 1, The What and Why of Agricultural Experiment Stations; No. 2, Illustrations of the Work of the Stations; No. 9, Milk Fermentations and their Relation to Dairying; No. 11, The Rape Plant; No. 14, Fertilizers for Cotton.

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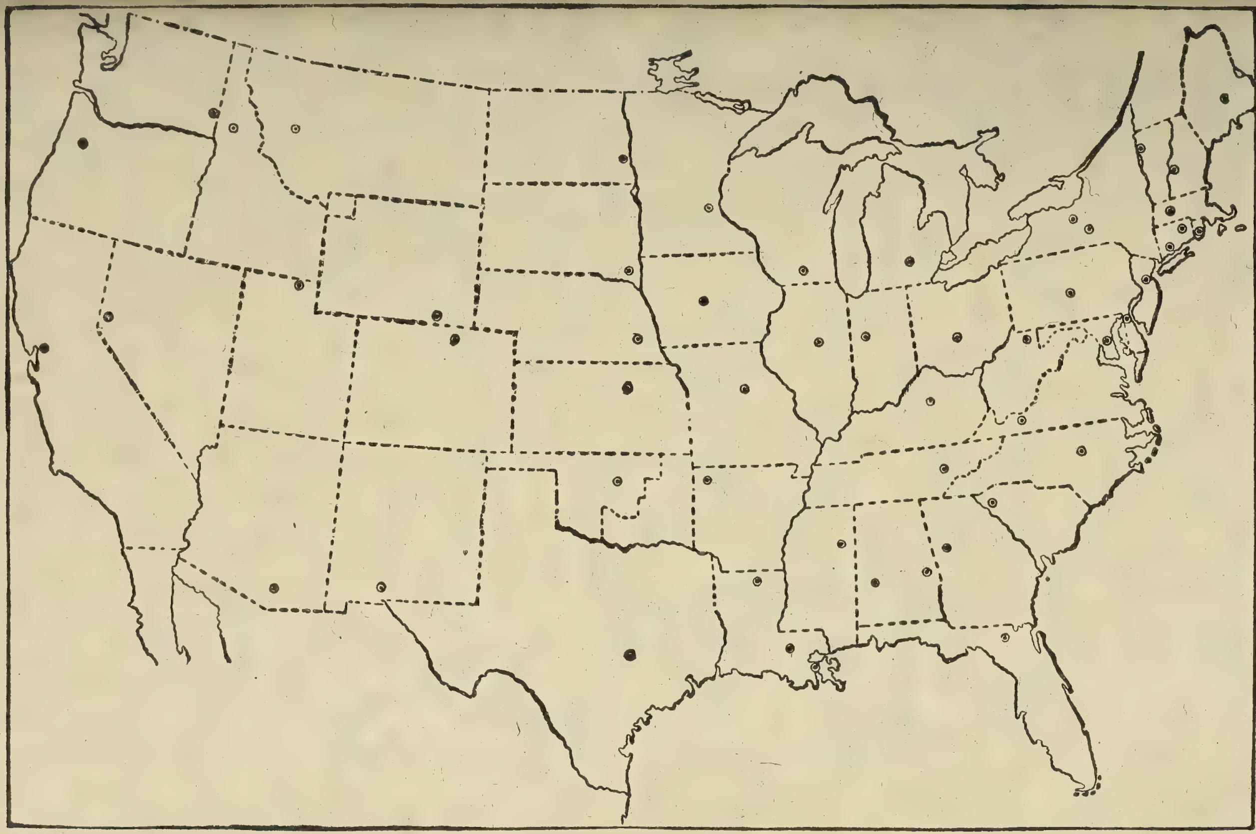

THE AGRICULTURAL EXPERIMENT STATIONS IN THE UNITED STATES.

R. Kent Beattie

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U. S. DEPARTMENT OF AGRICULTURE

OFFICE OF EXPERIMENT STATIONS

Vol. V No. 9

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WASHINGTON
GOVERNMENT PRINTING OFFICE
1894

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U. S. DEPARTMENT OF AGRICULTURE

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EXPERIMENT STATION RECORD.

Vol. V. No. 9.

A Division of Agricultural Soils has recently been established in the Weather Bureau of this Department. Prof. Milton Whitney, whose investigations in soil physics at the experiment stations in North Carolina, South Carolina, and Maryland have attracted wide attention, has been appointed chief of the new division. It will be the duty of this division to supplement the present work of the Weather Bureau by continuing the study of rainfall after it enters the soil, and of the temperature of the soil, and to keep a continuous record of the moisture and temperature conditions within some of the most important types of soil in the country. Rain is of little benefit to plants until it enters the soil, where it can be absorbed by their roots; so it is extremely important to continue the study of the rainfall further than has heretofore been done, and to keep a record of the amount and distribution of the moisture and temperature within the soils adapted to different agricultural crops. The actual conditions of air, moisture, and temperature which soils are able to maintain largely determine what classes of plants are adapted to the soils on account of the influences on their development, yield, texture, quality, vitality, and time of ripening. The relative amount of moisture maintained by different soils for the use of plants, and the relative temperature of soils, depend very largely upon their texture, so that, even with the same rainfall and exposure to heat, different soils may maintain very different conditions.

The meteorological conditions within the soil which are unfavorable to certain kinds of plants may be extremely favorable to other kinds, and may thus offer advantages for special agricultural operations which can not be carried on in other soils.

This adaptation of certain soils and localities to special crops and agricultural interests may be seen in all parts of the country, and is very largely due to the ordinary atmospheric meteorological conditions and to the relation of the different soils to these conditions.

When the conditions favorable to different agricultural interests are once ascertained, and when the conditions maintained by different types of soil are known, a basis will be provided for the classification and valuation of lands for different classes of crops and for the more intelligent improvement of lands.

It is coming to be believed, furthermore, that the deterioration of lands is not due directly to the loss of plant food by crops so much as to the change in physical conditions or structure of the soil, and a change in the conditions of moisture and temperature which the soil can maintain. Under the influence of the artificial conditions of cultivation, manuring, and cropping, the texture of the soil changes. It may become closer and more retentive of moisture, and supply too much moisture and too little air to the roots of plants, or it may become too open and porous and be too little retentive of moisture for the best development of plants.

To aid in carrying out the investigations planned, stations will be established in the most important established soil types, where records will be kept of the soil moisture and temperature by the regular or volunteer observers of the Weather Bureau, or, when these are not properly located for this work, by others who may be interested in the work. It is hoped that the experiment stations, the agricultural colleges, the State weather services, and other institutions and individuals interested in this line of work will coöperate as the investigations develop.

The recent report by H. Snyder upon a comparative study of the cultivated and uncultivated soils of Minnesota (p. 857) confirms in a striking manner the conclusion of Hilgard that "in case of soils cultivated without fertilizers, even for a considerable length of time, chemical analysis will afford us valuable indications not only regarding their general character but also in respect to the most important soil ingredients most likely to have been reduced below the level of profitable culture, [and] so long as virgin spots, fairly representing cultivated soils, exist, the results obtained by examination of the former can be fruitfully applied to the latter." The chief significance of the investition, however, seems to lie in the suggestions it conveys regarding the value of a careful study of the humus of soils.

As may be seen in the report referred to, a study of samples from all parts of the State of Minnesota of uncultivated soils and of those submitted to continuous grain cropping without rotation or other treatment from ten to fifteen years, showed that the humus and nitrogen in the latter has been reduced to from two thirds to one half of that in the former; and that the decline in fertility of the cultivated soils is clearly due to this decrease of humus, involving a decrease of available phosphoric acid as well as of nitrogen and a lessening of the water-holding power of the soil. This conclusion is further confirmed by the observed fact that mineral fertilizers alone have not been able to restore the original productiveness of these soils, but that the use of barnyard manure and the practice of a system of rotation which increases the organic matter of the soil has proved an effective means of renovation.

An exaggerated importance was attached to humus by the older agriculturists, who considered it a direct and essential element of plant

food, and believed that the amount of it present in a soil was a safe index of its fertility.

The so-called humus theory, promulgated by Einhof and Thear, rested in part, at least, upon the observed fact that such materials as animal excrement or well-rotted barnyard manure, which supplied the soil with an abundance of humus, possessed a marked fertilizing power. It was strengthened by the discovery of Petermann that soils contain a considerable amount of diffusible organic matter, and of Detmer that certain of the constituents of humus are, to a limited extent, taken up by pea plants. While the investigations of these and other scientists leave little doubt that some of the constituents of humus, as well as other organic substances, can be taken up directly by certain plants, the weight of authority, including De Saussure, Braconnot, Sprengel, and Liebig, is in favor of the view that, as regard agricultural plants at least, neither humus nor any of it components have any practical significance as direct food for plants. On the other hand Dehérain, who has investigated this subject for a number of years (E. S. R., vol. v, p. 18), maintains that while *Gramineæ* do not need humus, legumes (clovers, at least) require this substance, and that "it is probably to the disappearance of humus in a constantly unmanured soil that we must assign failures observed when we attempt to grow clover continuously on the same soil." As far as the results of his experiments have been published, however, there is little to prove that the beneficial effect of the humus on leguminous plants was not due to indirect rather than direct action in the soil.

It is fair to conclude that aside from improving the tilth, permeability, and absorptive power of soils the more important functions of humus are to supply by its decomposition the nitrogen required by plants, and the carbonic acid which renders plant food available. It, moreover, yields certain organic acids which, as Grandeau has pointed out, may assist materially in rendering the plant food elements of the soil available. According to Hilgard, the amount of phosphoric acid usually found associated with humus varies from one tenth to five tenths of the total amount in the soil, indicating in many cases the amount of this element available to plants in actual practice.

We see, then, that besides being a great reservoir of nitrogen,* seizing upon it and holding it back from waste by drainage and supplying it gradually by nitrification as the plant requires, humus is an indirect means of supplying the plant with other fertilizing elements.

While the investigations of Snyder may not have developed any new facts in relation to the nature and functions of humus in the soil, they suggest new lines of study, quicken interest in chemical soil analysis in general, and yield results of great practical significance. They confirm in an emphatic manner the statement of Storer, that "farmers are wholly

* Humus contains, according to Hilgard, 3 to 6 per cent of nitrogen in regions of summer rains, but a higher percentage in arid regions.

right in attaching great importance to the preservation of humus in their soils, though the old theories, by which the practice has been justified, are for the most part untenable."

Prof. F. Lamson-Scribner, of the Tennessee Agricultural College and Experiment Station, has been appointed agrostologist to this Department. The manner of Prof. Scribner's selection for the place testifies strongly to the high place he holds in the estimation of the leading botanists in the country. As soon as the creation of the place was decided upon, letters were addressed to twenty-four of the leading botanists in the country, advising them of this intention, and they were invited to suggest the names of persons whom they regarded as best fitted for the place. A majority of the parties so addressed recommended Prof. Scribner as the right man, provided his services could be secured. His duties will consist in the preparation of monographs on grasses, care of the grasses of the herbarium, identification of grasses sent to the Department for that purpose, correspondence on this subject, and supervision of any special investigation of grasses and forage plants which may be undertaken by the Department.

There are no means for estimating with any degree of accuracy the total value of the grass production of this country, but the value of the average hay crop exceeds $400,000,000, and while no data are available to estimate the annual value of the pasture lands, it is clear that, added to the hay value, a total grass product will result probably more valuable than any other single crop in the country. The importance of collecting and imparting useful information regarding our grasses is therefore evident.

METHODS OF STERILIZED SAND CULTURES EMPLOYED AT THE BERNBURG EXPERIMENT STATION.

PROF. H. HELLRIEGEL.

The Bernburg Experiment Station is of especial interest to all students of agricultural science from the fact that here Prof. Hellriegel and his associates discovered the relation between microörganisms and the acquisition of atmospheric nitrogen by plants. In connection with a previous article it was stated (p. 747) that the studies which led to this interesting and important discovery were made on sand cultures. The present paper describes the methods employed at the Bernburg Station when it is necessary to exclude bacteria and other microörganisms from the cultures.

NITROGEN AS FOOD OF THE LEGUMES.

Certain microörganisms, fungi or bacteria, are essential to some of the vital processes of legumes, and especially to their acquisition of nitrogen. If these organisms are excluded, that is to say, if the legumes are grown in pure sand which contains no organisms and none are introduced during growth, the legumes behave in exactly the same manner as the grasses. Under these circumstances they do not acquire nitrogen from the atmosphere, and their development is proportional to the quantity of nitrogen supplied them in the soil. When peas, lupines, etc., are grown in sand containing no nitrogen and deprived of these organisms the development of the plant proceeds until the nitrogen of the seed is exhausted. At this stage growth is checked and a starvation period sets in, just as in the case of oats or barley, and sooner or later the plant dies, usually before blossoming. Such a plant is found to contain almost exactly the same quantity of nitrogen as was originally present in the seed from which it grew. If a nutritive solution containing nitrogen, in the form of calcium nitrate for instance, is added to the sand in which the legumes are growing the growth of the plants continues and an amount of plant substance proportionate to the supply of nitrogen is produced. The yield, therefore, stands in a definite relation to the quantity of nitrogen at the disposal of the plant. One of the legumes best adapted to such a test is serradella. This

relation of dry substance to nitrogen supply is brought out by the following experiment:

Experiment with serradella in 1887.

Nitrogen supplied.	Yields of vine and seed.
Gram.	*Gram.*
0.000	0.078
0.056	2.883
0.112	6.540

The yield varies with the nitrogen supplied in the soil, and, as in case of the grasses, the total plant substance is found to contain somewhat less nitrogen than was originally added to the soil. The legumes, therefore, acquire no nitrogen from the atmosphere when microörganisms are excluded.

But the behavior of these plants undergoes a marked change if certain microörganisms are added to the soil. When this is done the legumes thrive in sa d free from nitrogen compounds and produce a normal yield. The entire amount of nitrogen required by the plant, exclusive of that in the sand, is supplied by the atmosphere. On examination the roots of these plants are found to be covered with the small knotty protuberances known as root tubercles. The roots of plants from which microörganisms have been excluded are found to be free from tubercles. These observations, made by Prof. Hellriegel and his associates, led them to infer that the root tubercles and the acquisition of atmospheric nitrogen by the legumes stood in the relation of cause and effect.

It has been known for a long time that these tubercles occur very generally upon the roots of the legumes, and they have been looked upon as pathological growths produced by microörganisms. Brunchorst advanced the view that they were normal parts of the roots, and this view is still held by many investigators, including Frank and Tschirsch. Later a number of botanists, as Lundstrom, Ward, Vuillemin, and Prazmowski, proposed the theory that they were fungus products, and recently Beyerinck has referred them to the action of bacteria.

Leaving the question as to the nature of the organisms, whether they are bacteria or other fungoid microörganisms, it has been demonstrated that the tubercles are produced by microörganisms. The following very striking experiment by Prof. Hellriegel and his associates is in point as demonstrating their action. A small trace of the contents of a lupine tubercle was removed by means of an inoculating needle and transferred to the punctured root of a germinating lupine plant, which was then planted by the usual method in sterilized sand. Four plants thus inoculated and one not inoculated were placed in each pot, the uninoculated plant being placed in the middle. After some time the plants were harvested. The main root of each inoculated plant was covered, in the vicinity of the puncture, with numerous

tubercles, while those of the uninoculated plants were free from them. Furthermore, dipping the germinating plants in water containing finely divided tubercles, or the addition of the contents of the tubercles to the sand in which the plants were grown, produced plants whose roots were covered by numerous tubercles, while in control experiments they were entirely wanting.

In the Bernburg experiments in 1886 to 1888 the plants were always inoculated by the addition of soil infusions to the sand. These were prepared by mixing a small quantity of a cultivated soil with water and allowing it to settle. The almost clear water was removed and used at the rate of 25 c. c. to each pot containing 9 pounds of sand. This quantity of infusion corresponded to about 5 grams of soil, and contained only from 0.3 to 0.7 mg. of nitrogen. It is, of course, impossible to explain the effects of the infusion by the action of these small amounts of nitrogen. The criticisms of these experiments by Frank are sufficiently confuted by the facts as since published.

When the sand has been inoculated in this manner the roots of the legumes planted in it become covered with tubercles. If, however, the infusion is first boiled or even heated at 70° C. for a short time and then added to the sand no tubercles are formed. This clearly proves that the question is one of the action of a fungus or other organism. Furthermore, it is proved that different kinds of plants require entirely distinct fungi, and that not every cultivated soil contains all of these fungi. For instance, the fungus which produces tubercles on the roots of peas does not produce them upon lupines, and a soil which contains the pea fungus in large quantities may be quite free from the lupine fungus. Such a soil would produce tubercles upon the pea roots but not upon those of the lupine, and in fact just such cases have been met with.

Characteristic differences appear, for example, between the beet soil used in the Bernburg experiments and a light sandy soil taken from where lupines were growing. When the sand of the station experiments is inoculated with an infusion from the beet soil, tubercles will be formed upon peas, vetches, lucern, and kidney vetch, but not upon lupines or serradella. The same sand when treated with an infusion of the lupine soil will produce tubercles upon lupines, serradella, peas, and vetches, but none upon lucern and kidney vetch. These experiments are especially striking when the different plants are cultivated in the same pot so that those with and without tubercles may grow together, as will be referred to later.

The best development and largest number of the tubercles are attained in soils quite free of nitrogen, and if the soil contains very much nitrogen the formation of tubercles may be altogether suppressed even when the fungus necessary to produce them is present. Almost nothing is known regarding the functions of these tubercles. They are certainly not reserve supplies of plant food, but on the other hand they clearly have to do with the assimilation of nitrogen.

METHOD OF STERILIZED SAND CULTURES.

In experiments upon nutrition with nitrogen the action of all sources of this element not contemplated in the plan of the experiment must of course be excluded. The absolute purity of all materials used must therefore be insured. Furthermore, the glass pots should be painted so as to render them nontransparent and thus prevent the growth of algæ in the cultures, since, according to late investigations, these acquire the nitrogen of the atmosphere.

If it were a question of keeping out all bacteria in the filling of the pots, and during the entire period of vegetation, the greatest pains would be necessary; but the matter is somewhat simplified in such cases as that of the experiments referred to, where only bacteria which produce the root tubercles of the legumes have to be excluded. As a rule these bacteria are abundant in every cultivated soil, and hence they occur everywhere in dust. But if they do multiply at all in the soil they do so very slowly, and are diffused but little, at least in the sand used in these experiments. From this it would seem that these bacteria can only develop in young roots. It thus becomes possible to make arrangements to fill and plant a hundred pots in the spring and to maintain them throughout the entire period of vegetation without infection. It would be quite impossible to keep control of such a number of experiments as this if it were a question of the complete and certain exclusion of bacteria. This point should be kept in mind in considering the methods here described for filling the pots and managing the plants.

The sand used in these cultures is sterilized by heating to a temperature of at least 150° C. This is done in kettles in the preparation room. An iron kettle, built into a furnace, is filled to the depth of several inches with sand. This contains a second smaller kettle in which the sand to be sterilized is placed in a layer about 6 inches deep. The inner kettle, which is easily removed, is made of heavy sheet iron and provided with a cover. It holds from 125 to 170 pounds of sand. The sand is sifted into the kettle through a 0.5 mm. sieve, and the fire increased until the upper stratum of the sand reaches a temperature of at least 150° C. This temperature is maintained for at least two hours. The products of combustion from the furnace come in contact with only the outside of the outer kettle, so that the iron of the inner kettle never becomes heated enough to be oxidized. It is very important to avoid the admixture of iron oxide with the sand, and to prevent this only the sand which can readily be removed from the kettle is used.

Meanwhile the pots are carefully cleansed and the quartz pebbles and cotton placed in them, as described in the preceding paper, and all the pots are brought to the same weight. The pebbles are then removed from each pot and placed in small shallow boxes made of wire gauze, each of which is provided with a tag bearing the number of the pot from which the pebbles were taken. All the boxes and disks of

cotton are then sterilized by heat in a large drying oven made of iron and asbestus. All the apparatus used in filling the pots, as spoons and scoops for transferring and packing the sand, measuring glasses, mortars, etc., are placed in the oven and heated for two hours at 150° C.

The nutritive solutions are measured out as usual, the phosphoric acid salts being kept separate, and made up to 300 and 200 c.c. respectively. The flasks are closed with a plug of cotton and the solutions boiled for at least half an hour. Nutritive solutions which may undergo decomposition by this boiling, as, for example, dibasic ammonium phosphate, are sealed up in glass tubes and heated in a water bath. Calcium carbonate and other solid admixtures are sterilized in the drying chamber. Water is sterilized by boiling in flasks, or, if large quantities are required, sterilized water may be obtained directly from the copper still in the following manner: The water is first removed from the condenser and steam allowed to pass through the coil. Water is then returned to the condenser and the distillate caught in a large sterilized glass flask into which the end of the condenser is introduced, the mouth of the flask being tightly plugged with cotton. The flask is previously sterilized by washing with a solution of bichloride of mercury, 1 : 1000, and subsequent rinsing with sterilized water. When the flask is filled it is tightly closed with cotton and an inverted beaker and set aside until needed. The water is removed from these flasks by means of a sterilized siphon, the short arm of which is introduced through the cotton. The end of the long arm is closed by means of a rubber tube and pinchcock and the end of the tube below the pinchcock is covered with cotton. To protect the end of the tube from contamination a test tube is slipped over it, the test tube being just wide enough to fit tightly over the cotton with which the tube is covered. All the apparatus not already mentioned is sterilized with a solution of bichloride of mercury, 1 : 1000.

The pots are again carefully cleaned, rinsed with the bichloride solution, and wiped out with cotton soaked also in the bichloride solution. They are next allowed to drain for a time and finally rinsed twice with sterilized water.

The pots are filled in a room quite free from dust and the tubes, scales, etc., are washed with bichloride of mercury. When the apparatus in the drying oven has become cool it is removed and the pebbles are taken out of the boxes and placed in the pots to which they belong. As this has to be done with the hands, the latter must be previously sterilized. They are first thoroughly washed with soap; the finger nails are cleaned, and the hands dipped in bichloride solution and finally rinsed with sterilized water or with alcohol. The porcelain or enameled dish used to hold the sand is sterilized, as well as the pots, with bichloride of mercury.

The sand is weighed out in the dish and the nutritive solutions are poured together and mixed with it by the aid of spoons. The sand is then

transferred to the pot as usual. The operation requires two persons, the hands of one of whom must be sterilized. Before the pots are filled quite full a glass tube to be used later in adding water is introduced. This tube is bent to form two arms at right angles to each other, the longer arm being in form of a circle. The circular arm is placed in a horizontal position $1\frac{1}{2}$ to 2 inches below the surface of the sand with the end of the short arm projecting a little above the surface. The end of the long arm is closed, and its underside is perforated with a number of small holes through which the water can pass slowly into the soil. The end of the short arm which projects above the surface of the sand is fitted with a rubber tube and covered with cotton (Fig. 20). This end is protected from contamination by a test tube in precisely the same way as the outlet to the siphon described above. The surface of the sand is covered with a disc of sterilized cotton and carefully protected from dust until ready for the planting.

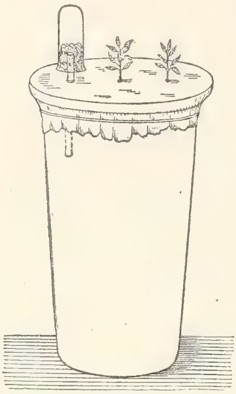

FIG. 20.—Sterilized sand cultures.

The question whether the culture medium is damaged to the disadvantage of the plant by sterilization is not settled. As regards the sand it is not to be supposed that any changes can take place at the temperature to which it is heated. The lower portions reach a temperature considerably above 150° C., very likely several hundred degrees, but are far from reaching red heat. In the experience of the station various plants, both *Gramineæ* and *Leguminosæ* have developed normally in sand sterilized in this way and without the appearance of any harmful symptoms. The inference is that the sand was unaltered. Changes are, however, more likely to occur in sterilizing the nutritive solutions, as the glass in which they are boiled is attacked by steam. There are many kinds of glass in the market which render water perceptibly alkaline on boiling. In selecting glass vessels for this kind of experimenting it is well to take pains to get glass which resists this solvent action. To prevent chemical decomposition of the nutritive solutions, those which would decompose when mixed should be sterilized separately.

STERILIZING AND PLANTING THE SEED.

The seeds also must be sterilized in order to prevent their carrying germs into the pots. To this end they are immersed for two or three minutes in a solution of bichloride of mercury 1:1000, with agitation to remove the air bubbles. Some kinds of seed, as lupine, which do not readily absorb water, are first allowed to soak for a short time in water until the outer layer has become thoroughly wet and then sterilized with bichloride solution.

After sterilization all seeds are repeatedly washed with boiled water and placed in the germinating medium. This medium consists of moist sterilized sand, which is placed in a crystallizing dish, covered by a second dish just large enough to slip over it. Both pans are sterilized with bichloride solution.

The seeds are planted as soon as they have germinated. In planting the use of two large platinum spatulas is recommended—a straight one for loosening the germinated seeds and a bent one for pressing them into the sand of the culture pot. A pair of forceps and a platinum dish in which to lay these implements when not in use are also very convenient. These all may be easily sterilized by heating to redness. When the planting is finished the pots are lightly covered with discs of cotton batting which have been previously sterilized in the drying oven, and allowed to stand in a place free from dust until the germinating plantlets make their appearance.

In spite of the pains taken, the cultures may become contaminated very easily at this time and it is therefore necessary to provide the pots with a tightly fitting cover as soon as possible. Instead of planting twice as many seeds as the number of plants required, it is well to use a smaller number, proportionate to the quality of the seed. If it has been found that all of the seeds will germinate it is only necessary to plant as many seeds as the number of plants needed. In the latter case it will, of course, be unnecessary to remove any of the plants, and in this way one source of contamination may be avoided. Replanting should be avoided for the same reason.

The next problem is to devise a cover for the pots which shall exclude bacteria and at the same time afford sufficient ventilation. The fine, sifted peat. which is used as an admixture with the sand in the sugar-beet cultures, is found to answer this purpose. In order to keep the peat dry it is necessary to separate it from the surface of the sand of the cultures. This is done by simply covering the culture sand with a layer of coarse sand, with grains 2 to 3 mm. in diameter. The peat is then placed upon the coarse sand in a layer about one third of an inch thick or even with the brim of the pot, and the pot covered over with a fine, but not too tightly woven, cloth or gauze. The meshes of the cloth must be large enough to permit circulation of air, but at the same time fine enough to prevent the wind from blowing the peat out. Holes must be made in this cloth large enough to let the plants through. The cloth should be so soft that the edges of the openings will not scratch the stems of the plants. The layers of coarse sand and peat are not placed in the pots until the plantlets, still under the cotton, have grown above the top of the pot. With legumes, which raise their cotyledons above the soil, care must be taken not to add the coarse sand, etc., until they are well above ground, as otherwise the cotyledons would leave a large hole through which infection might easily take place later. When all the plants have grown through the

cloth cover more peat is added and the cover is tied tightly down. The holes around the stems of the plants are closed with cotton or cloth, and the cover is not removed again during the entire period of vegetation.

WATERING THE STERILIZED CULTURES.

The glass tube through which water is added of course projects through the peat and cloth, and its end is kept closed against the bacteria by means of the test tube and pad of cotton.

The watering is done as follows (Fig. 21): The sterilized water is contained in a glass vessel of about 50 kg. capacity, the mouth of

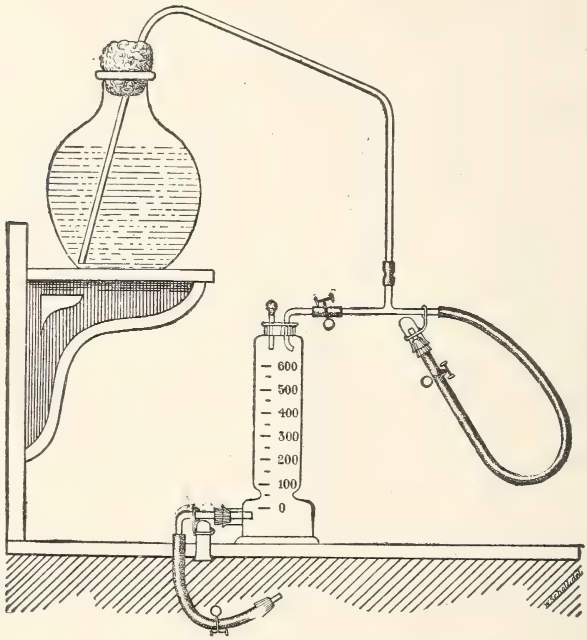

FIG. 21. Apparatus for watering sterilized sand cultures.

which is plugged with cotton. A siphon has been previously introduced, the longer end of which is connected with the top of a measuring cylinder provided with a tubulature at the bottom. The siphon may be closed by a pinchcock placed just above its entrance into the cylinder. The stopper which closes the top of the cylinder is fitted with a glass tube filled with cotton to allow the escape of air on filling the cylinder with water. The tubulature at the bottom of the cylinder is provided with a long rubber tube, to the end of which is attached the short glass tube. The siphon does not lead directly into the cylinder, but is divided by a T tube, one end of which is directly connected with the cylinder, and the other used for drawing sterilized water for purposes other than watering the pots. To the end of this second

branch is attached a long rubber tube, which is terminated by a short glass tube. To protect the ends of these two branches of the siphon from contamination small corks are slipped over them, and over these are pressed, immediately after use, two glasses similar to test tubes. These tubes are made of fairly wide and thick glass tubing and are suspended with the open end downward from the T tube.

Before watering the pots are weighed to ascertain how much water is to be added. The cock is opened and the requisite amount of water allowed to run into the graduated cylinder. The outlet tube is introduced into the watering tube of the pot as quickly as possible after the removal of the protecting cap. The measured quantity of water is allowed to flow from the cylinder into the pot, and then the tube is immediately returned to the cap. If during the operation the tube happens to come into contact with any object which has not been sterilized it must, of course, be sterilized again.

By means of this arrangement it is possible to water a large number of plants with very little danger of infection.

STUDY OF THE ACQUISITION OF NITROGEN BY LEGUMES.

Let us now consider the behavior of legumes grown in sand free from nitrogen, but containing the necessary amounts of the other soil ingredients of plant food, as potash, phosphoric acid, etc. If the bacteria are excluded, the plants which are developed at the expense of the nitrogen of the seed are small and half starved, and when this supply is exhausted they gradually die. If, on the other hand, the requisite bacteria are added to the sand in the soil infusion, the weak and starving plants develop until the nitrogen in the seed is used up. Then they remain for some time in this starvation stage, but all the time the tubercles are forming upon the roots. When, however, these tubercles have developed, the plant suddenly becomes green and the growth luxuriant, which ordinarily comes with abundant supply of nitrogenous manure. The behavior of the common vetch (*Vicia sativa*) is specially striking. The plant is at first half starved and has a slender stem and small leaves, but as soon as the tubercles have developed upon the roots a second shoot of normal thickness and with well-developed leaves appears at the base of the stem, the original plant in the meantime slowly dying off. It is evident that from this time on the plant has at its disposal a new and abundant source of nitrogen, which was not present before.

Numerous experiments have been made at the station with peas, lupines, and serradella. All these plants, when grown in nitrogen-free soils, give an abundant yield, produce numerous seeds, and behave in a normal manner in every particular if the proper fungi are supplied in the soil infusions.

This is illustrated by four experiments with lupines in 1888. The plants were grown in pots holding 17½ pounds of sand, two plants in

each pot. All received the same quantities of mineral plant food without nitrogen and the same amounts of soil infusion. In the case of the first two the fungi had been killed by boiling, while infusions which had not been boiled were added to the last two. The nitrogen in the entire yield was determined, and also that originally contained in the seed and added in the soil infusion. The difference between the first amount and the sum of the last two represents the amount of nitrogen acquired from the atmosphere. In the first two experiments that yield was very small and there was no gain, but instead a slight loss of nitrogen, while in the last two the yield is considerable and the increase in the amount of nitrogen is well marked. The results are summarized herewith:

Lupines, 1888.

No.	Treatment.	Dry matter produced.	Nitrogen acquired from the atmosphere.
		Grams.	*Grams.*
1	Sterilized	0.926	—0.007
2	do	1.008	—0.007
3	Inoculated	42.681	+1.147
4	do	40.574	+1.054

Mixed cultures.—For this experiment a number of different kinds of seeds were sown in one pot in order to determine the effects of the same kind of bacterium upon the different plants. The seeds were sown in 4 culture pots, 40 cm. in height and 20 cm. in diameter, holding 16 kg. of sand each. The nutritive solutions mentioned above were used as there described, and everything was sterilized. Two of the pots were inoculated with an infusion of the beet soil, and the other two with that of the lupine soil above mentioned. The infusions were added to each pot at the rate of 80 c. c., corresponding in each case to 16 grams of the dry soil. The following kinds of seeds were planted at the same time in each pot: *Avena sativa*, *Brassica rapa annua*, *Helianthus annuus*. *Cannabis sativa*, *Trifolium pratense*, *Vicia sativa*, *Pisum sativum*, *Ornithopus sativus*, and *Lupinus luteus*. Thus nine kinds of plants were placed in one pot, occupying all together only a small space, and subject to exactly the same conditions as regards plant food. Therefore, if any peculiarity of the soil itself or any condition induced by the process of sterilizing were to affect the development of the plants, it would act upon all in the same way. The only difference in the conditions of the experiment was that in case of pots *a* and *b* the inoculation was with an infusion of beet soil, and of pots *c* and *d* with an infusion of the lupine soil. In all cases the soil material may be assumed to have been without any appreciable quantity of nitrogen.

The results of these experiments correspond to those previously obtained. The non-leguminous plants died of starvation in all four of the pots. *Ornithopus* and *Lupinus*, in pots *a* and *b*, which had received

the beet soil infusion, behaved exactly like the non-legumes, and no tubercles appeared upon their roots. In pots *c* and *d*, on the other hand, these two kinds of plants had numerous normally developed tubercles upon their roots. In contrast with both these kinds of plants, *Trifolium* was early and well developed only in pots *a* and *b*, which had been inoculated with beet soil infusion, while in pots *c* and *d* inoculated with lupine soil infusion it remained for a long time in the complete starvation stage, and began to assimilate very late, and then with but little energy. Finally *Vicia* and *Pisum* formed tubercles in all four pots and grew everywhere quickly and satisfactorily.

Thus, under absolutely the same experimental conditions, the infusion of beet soil was ineffective with the non-leguminous and likewise with *Ornithopus* and *Lupinus*, but exerted a good effect upon *Trifolium*, *Vicia*, and *Pisum*. The lupine soil infusion was without action upon the non-legumes, but exerted a beneficial influence upon the growth and assimilation of nitrogen by nearly all the legumes employed, its effect being doubtful only in case of *Trifolium*.

All four pots were planted on April 18; *a* and *b* were harvested August 2, and *c* and *d* August 20. The degrees of development which the various kinds of plants had reached at this time were naturally very different; the peas, which require only a short time for growth, were completely ripe, the vetch and lupine partly so, while the serradella was quite grown, and the perennial red clover still in the first period of growth. The amounts of dry substance which the plants produced up to that time are given below:

Dry substance of plants produced after inoculation with different soil infusions.

Plant.	Beet soil infusion.		Lupine soil infusion.	
	Pot *a*. Weight.	Pot *b*. Weight.	Pot *c*. Weight.	Pot *d*. Weight.
	Grams.	*Grams.*	*Grams.*	*Grams.*
Brassica	0.010	0.017	0.006	0.015
Cannabis	0.025	0.055	0.047	0.046
Helianthus	0.305	0.493	0.330	0.644
Avena	0.257	0.153	0.140	0.238
Ornithopus	0.015	0.010	2.002	2.560
Lunipus	0.093	0.155	17.133	30.597
Trifolium	2.213	3.241	0.363	1.589
Vicia	15.971	6.132	6.678	5.181
Pisum	12.282	32.640	16.152	6.021

Cultures in confined air in glass vessels.—These experiments were made in order to obtain proof that the legumes are able to assimilate the uncombined nitrogen of the atmosphere, for which purpose the plants had to be grown in a completely inclosed air space. The arrangements of the experiment were as follows:

An acid carboy of 44 liters capacity, made of white glass, with a tight-fitting ground-glass stopper, was used as a receptacle in which to grow the plants. In it were placed 4 kg. of the quartz sand which had

been ignited in a crucible at high heat for two hours. The following food ingredients were added:

	Grams.
Calcium carbonate (dry)	4.000
Potassium monophosphate (in solution)	0.544
Potassium chloride (in solution)	0.238
Calcium chloride (in solution)	0.222
Magnesium sulphate (in solution)	0.240

Twenty-five cubic centimeters of an infusion of soil from the experimental field was also applied. This quantity of infusion corresponded to 5 grams of soil, and contained, as found by two concordant analyses, 15 mg. of nitrogen. Enough distilled water was added to bring the moisture of the sand up to 17.5 per cent (70 per cent of its water-holding capacity). The sand was placed in a small heap about 10 cm. high on the bottom of the carboy by means of a long-handled spoon, and on June 6 a pea was planted in it.

The carboy was supported, at a suitable distance from the ground, outside the greenhouse, on the north side of the latter. In this position it received not only diffused but also direct sunlight, although only after the light had passed twice through thick glass. In this way much of its intensity was lost by reflection and absorption. The pea germinated normally, and grew well as long as the supply of reserve food lasted. At the beginning of the fourth week in June it entered upon a well-marked period of starvation, but early in July began to become green again and to show signs of growth. The quantity of carbon dioxide which the inclosed air originally contained was too small to allow the growth to proceed, and therefore an artificial supply had to be introduced. This of course necessitated opening the carboy. The requisite quantity of pure and well-washed carbon dioxide was collected in a graduated bell jar with a wide tubulature, and introduced quickly, by pressure, into the carboy. The time during which the carboy was kept open never exceeded two minutes. A retardation in the growth of the plant always showed most plainly when a fresh supply of carbon dioxide was needed. The following amounts were added: June 25, 1 liter; July 9, 2½ liters; July 21, 2½ liters; July 29, 2½ liters.

An oat and a buckwheat kernel were planted in the carboy by the side of the young pea plant when the carbon dioxide was added on June 25.

The arrangement of this experiment allowed the addition of carbon dioxide only at intervals and always in large quantities. If it be borne in mind that the carboy had a capacity of 44 liters only, and that the amount of carbon dioxide added was usually 2½ liters, it will be seen that from time to time the pea plant was in an atmosphere containing more than 5 per cent by volume of carbon dioxide. This was without visible injury to the plant.

There was also no bad effect from the gradual increase in the quantity of oxygen in the air of the carboy until it had reached about 30 per cent

by volume, but when this point had been passed abnormal phenomena in the growth of the plant began first to appear. The pea not only grew under the conditions of the experiment, but grew very energetically, as may be seen from the fact that during the period of its most active vegetation it consumed in twenty days (July 9 to 29) not less than 5 liters of carbonic acid, and the last half of this amount, $2\frac{1}{2}$ liters, within a week (July 21 to 29). The rapidity and vigor of growth may also be inferred from the yield. The following figures are for the total weight of the plant, dried at 100° C. to a constant weight:

		Grams.
First cutting, harvested August 31	Seed	0.376
	Vines, etc.	6.173
Second cutting, harvested October 4	Vines	2.320
	Roots	1.290
Total		10.359

In contrast to this the oat and buckwheat plants, although close beside the pea plant, had lived in a starving condition. Both had developed weakly blossoms, but produced no seed. The yield of dry substance on October 4 was as follows: Oat, entire plant, with roots, 0.160 gram; buckwheat, entire plant, with roots, 0.036 gram.

The air of the carboy was originally the atmosphere of the station garden, and, unfortunately, was neither analyzed nor purified in any manner at the beginning of the experiment; it therefore undoubtedly contained a certain quantity of combined nitrogen.

The amount of combined nitrogen in 100 liters of air recorded in actual analysis never has exceeded 1 mg. We may, then, be excused for laying little stress upon the analysis or purification of the air within the carboy, and for drawing up the final nitrogen balance of the experiment, as follows:

Nitrogen balance.

	Gram.
Combined nitrogen in the air originally filling the carboy, less than	0.0001
In the sand	None.
In the nutritive solutions and twice distilled water	None.
In the soil infusion	0.0002
In the 3 seeds as follows:	
Pea	0.0081
Oat	0.0007
Buckwheat	0.0004
Total nitrogen supplied	0.0095

Nitrogen found at the end of the experiment:

	Gram.
In the pea plant	0.2335
In the oat plant	0.0033
In the buckwheat plant	0.0006
In the soil	0.0207
Total found	0.2581
Total supplied	0.0095
Difference	0.2486

The resultant gain was 0.2486 gram of combined nitrogen, for which the only source was the free nitrogen of the air.

In the following year this experiment was repeated, the solid glass stopper of the carboy being replaced by one carrying two tubes, so that the carbonic acid could be introduced without the necessity of opening the carboy. Several such experiments were conducted with results similar to those above described.

Experiment in proof that tubercles are formed through inoculation.—A large number of peas were planted in a crystallizing dish in sterilized sand which was moistened with distilled water only. After several leaves had appeared the plants were carefully washed, and such were selected as had developed a vigorous pair of roots instead of a single tap root. Among these were found four plantlets (Nos. 380 to 383) the roots of which consisted of two separate systems of the second order, developed approximately alike. After the amputation of a few roots of the second order which were growing on the stump of a tap root, the plants were placed in distilled water which had previously been boiled. They were allowed to remain in this water until the roots had reached the necessary length, when each plant was transferred to the following simple apparatus.

Two glass cylinders (ordinary white glass beakers) were fastened upon a small board with their edges touching and were covered with a single zinc cover into the middle of which an open tube was soldered. The plant was supported within this tube in the ordinary way by means of a perforated split cork and cotton, but in such a position that it was directly over the point of contact of the edges of the two beakers, with one half of the root system in beaker A and the other in beaker B. Each of the 4 pairs of beakers was filled with portions of one and the same solution, containing the following amounts of salts per liter:

	Gram.
Potassium monophosphate	0.363
Potassium carbonate	0.322
Calcium chloride	0.148
Magnesium sulphate	0.160

A quantity of soil infusion corresponding to 5 grams of soil was added as previously described, the soil being taken from a bed in the station garden which had been planted with peas in 1886. To glass A of each pair the solution was added fresh, but that with which glass B was supplied had been previously boiled for half an hour over an open flame and for four and a half hours in a steam sterilizer. The arrangement of the experiment was therefore such that one half of the roots of each of the four plants was immersed in a nutritive solution containing living microörganisms, while the other half was in a solution identical with the former but sterilized.

The plants were placed in this apparatus July 30; at this time no tubercles had formed on the roots nor could any signs of their appear-

ance be detected. All were in an advanced stage of the starvation period, all the leaves up to the next to the last being quite colorless.

No striking changes in the vegetation occurred during the first nine days, but the roots grew slowly and equally in all the beakers. Beginning with August 9 there was an unmistakable and well-defined formation of tubercles upon the roots of plants Nos. 380, 381, and 382; but it was a very striking fact that they occurred only upon the halves of the root system which were supplied with fresh soil infusion, namely, those in beaker A, while no tubercles appeared on the other halves of the roots, which were immersed in the sterilized solutions in beaker B.

The further development of the tubercles continued rapidly, and on August 15 in case of plant No. 380 they were almost as numerous as when peas are grown in the soil under normal conditions. In places they were crowded together like a string of beads and in other places they were some distance apart. The tubercles on plant No. 381 were nearly equal to those of No. 380 in this respect. In plant No. 382 the development of tubercles was less pronounced, but 18 of about the size of a pin head were counted. Plant No. 383 developed none at all and was almost dead.

EXAMPLES OF NITROGEN EXPERIMENTS WITH LEGUMES.

Illustrative of the results obtained in experiments with leguminous plants grown with and without inoculation with microörganisms, the following data from actual experiments with peas, serradella, and lupines are given:

Experiments with peas.—Four experiments, numbered here 1, 2, 3, and 4; culture pots, 6 inches high and 3½ inches in diameter; 9 pounds of sand per pot; moisture, from 10 to 17½ per cent of the weight of the soil, or from 40 to 70 per cent of the water-holding capacity of the sand; average weight of one seed 228.5 mg.; limit of weight 220 to 240 mg.; 4 seeds per pot.

Experiment No. 1.

Nutritive solution per pot	4 c. c. solution containing 0.5444 gram KH_2PO_4. 4 c. c. solution containing 0.2984 gram KCl. 4 c. c. solution containing 0.2220 gram $CaCl_2$. 4 c. c. solution containing 0.2400 gram $MgSO_4$.

Four grams calcium carbonate was added to each pot. Soil infusion was also added. Yield of dry matter 16.61 grams, of which 1.46 grams was seed.

Experiment No. 2.

Nutritive solution per pot	6 c. c. solution of K_2HPO_4. 4 c. c. solution of KCl. 4 c. c. solution of $CaCl_2$. 4 c. c. solution of $MgSO_4$.

Soil infusion was also added. Yield of dry matter 22.05 grams, of which 10.82 grams was seed. In this case dipotassium phosphate was used and calcium carbonate was omitted.

Experiment No. 3.

Nutritive solution per pot	6 c. c. solution of K_2HPO_4. 4 c. c. solution of $CaCl_2$. 4 c. c. solution of $MgSO_4$. 4 c. c. solution of KCl. 32 c. c. solution of NH_4NO_3.

No soil infusion was added and the plants were grown in sand which was kept sterilized during the entire experiment. Yield of dry matter, 18.81 grams, of which 2.22 grams was seed. The roots were free from tubercles.

Experiment No. 4.

Nutritive solution per pot	6 c.c. solution of K_2HPO_4. 4 c.c. solution of $CaCl_2$. 4 c.c. solution of $MgSO_4$. 4 c.c. solution of KCl. 32 c.c. solution of NH_4NO_3.

Soil infusion was added. Yield of dry matter, 28.05 grams, of which 10.56 grams was seed. Tubercles were formed on the roots.

Experiments with serradella.—Two experiments, numbered here 1 and 2; pots 6 inches in height and 3½ inches in diameter; 9 pounds of sand; moisture, from 10 to 17½ per cent during the vegetation period or from 40 to 70 per cent of the total water-holding capacity of the sand. Several seeds were planted and four plants were allowed to grow.

Experiment No. 1.

Nutritive solution per pot	4 c.c. solution of KH_2PO_4. 4 c.c. solution of KCl. 4 c.c. solution of $CaCl_2$. 4 c.c. solution of $MgSO_4$.

Inoculated with soil infusion. Yield of dry matter, 16.86 grams, of which 1.35 grams was seed.

Experiment No. 2.

Nutritive solution per pot	4 c.c. solution of KH_2PO_4. 4 c.c. solution of KCl. 4 c.c. solution of $CaCl_2$. 4 c.c. solution of $MgSO_4$. 4 c.c. solution (0.276 gram) K_2CO_3.

Inoculated with soil infusion. Yield of dry matter, 12.53 grams, of which 0.18 gram was seed.

Experiments with lupines.—Three experiments, numbered here 1, 2, and 3; culture pots, 10 inches in height and 3½ inches in diameter; 17½

pounds of sand per pot; moisture, at the beginning of the experiment, from 8 to 10 per cent, but about the middle of July it was increased to 8 to 12 per cent in those pots where evaporation was most rapid on account of the more vigorous growth of the plants. Four seeds planted; two plants allowed to grow.

Experiment No. 1.

Nutritive solution per pot: 4 c.c. solution of K_2HPO_4. 4 c.c. solution of KCl. 4 c.c. solution of $CaCl_2$. 4 c.c. solution of $MgSO_4$.

Inoculated with soil infusion. Yield of dry matter, 44.72 grams, of which 8.16 grams was seed.

Experiment No. 2.

Nutritive solution per pot: 3 c.c. solution of $Ca(NO_3)_2$. 32 c.c. solution of NH_4NO_3. 3 c.c. solution of $Mg(NO_3)_2$. 12 c.c. solution of KNO_3. 4 c.c. solution of $(NH_4)_2SO_4$. 5 c.c. solution of $(NH_4)_2HPO_4$.

Not inoculated; soil kept sterilized during entire period of growth. Yield of dry matter, 42.36 grams, with no seed. An extremely large supply of nitrogen is necessary to produce the maximum yield of lupines. If the entire quantity of nitrogen is added when the pots are filled the effect is detrimental to the plants during the first stages of their growth, but as a general rule they recover at a later period. Even this large quantity of nitrogen, however, did not produce the development of seed. This is best obtained if the nitrogen is added when the plants are in blossom; it may be given in a single large portion, but more advantageously in several smaller ones. In the following experiment, in which the nitrogen was supplied in the latter way, a marked increase in the amount of seed was produced:

Experiment No. 3.

		Added—	
		April 27.	July 21.
		C.c.	*C.c.*
Nutritive solution per pot..	Solution of $Ca(NO_3)_2$	4	2
	Solution of NH_4NO_3	23	24
	Solution of $Mg(NO_3)_2$	4	2
	Solution of KNO_3	12	4
	Solution of $(NH_4)_2SO_4$	4	2
	Solution of NH_4Cl	6	2
	Solution of $(NH_4)_2HPO_4$	5	2

Yield of dry matter, 46.53 grams, of which 10.90 grams was seed.

NUTRITION OF GRAMINEÆ WITH NITROGEN.

The results of a series of experiments with barley are here described. The general conditions of these experiments were as follows: Culture pots, 6 inches high and about 3½ inches in diameter; 10 pounds of sand per pot. The soil moisture during vegetation varied from 17.5 to 8.75 per cent of the weight, or from 70 to 35 per cent of the water-holding capacity of the sand. *Hordeum distichum* (variety, Chevalier barley) seed was used. Its specific gravity was 1.244 to 1.269; weight of air-dried kernels, from 38 to 44 mg.; average weight of kernel, 41.26 mg.; moisture content, 12.32 per cent. Fourteen seeds were planted in each pot; seven were removed after they had come up and seven allowed to remain until completely developed. The seed came up April 27–29 and the plants were harvested August 1.

Four grams of calcium carbonate was mixed with the entire sand of each pot while dry and then the following quantities of salts added in solution:

	Gram.
Potassium monophosphate	0.5444
Potassium chloride	0.1492
Magnesium sulphate	0.2400

Lastly the amounts of calcium nitrate, ranging from 0.164 to 1.968 grams, were added to twelve of the cultures, the solution being mixed with the others and added all together.

The following data were obtained at the harvest. They show most clearly that the quantity of material produced by the plants varied directly with the quantity of nitrogen supplied. Indeed, this is so manifest that comment is unnecessary:

Numerical statistics of plants harvested.

Experiment No.—	Nitrogen supplied.	Number of stalks with ears.	Number of stalks without ears.	Length of the seven stalks, not including the awn.	Total number of seeds produced.	Number of perfect seeds produced.
	Grams.			*Cm.*		
1	0.336	21	23	68–70	470	306
2	0.224	15	24	67–82	311	263
3	0.224	13	20	67–78	290	232
4	0.224	14	21	73–84	314	260
5	0.168	12	19	66–82	241	194
6*	0.112	7	15	*36–74	*124	*101
7	0.112	7	18	54–74	147	124
8	0.112	8	16	72–78	152	126
9	0.056	7	14	43–56	108	78
10	0.056	7	14	45–52	88	77
11	0.056	7	14	25–54	89	70
12	0.028	7	7	27–42	51	43
13	None.	6	1	13–18	10	8
14	None.	7	0	11–18	11	3

*One of the ears in pot No. 6 was eaten up by sparrows. The nets mentioned in the previous paper in the description of arrangements for the experiments were not in use in 1883 when these experiments were made.

Weights of materials harvested.

Experiment No.—	Nitrogen supplied.	Yield of dry substance.				Percentages of—			Average weight of dry substance of one kernel.
		Grain.	Chaff.	Straw.	Total.	Grain.	Chaff.	Straw.	
	Grams.	*Grams.*	*Grams.*	*Grams.*	*Grams.*				*Mg.*
1	0.336	10.3866	3.1408	15.8156	29.3430	35.4	10.7	53.9	33.9
2	0.224	8.1042	1.7680	11.2015	21.0739	38.5	8.4	53.1	30.8
3	0.224	7.4952	1.8102	11.1545	20.4599	36.6	8.9	54.5	32.3
4	0.224	8.7280	1.8880	11.1102	21.7262	40.2	8.7	51.1	33.6
5	0.168	6.1686	1.2770	8.9426	16.3882	37.6	7.8	54.6	31.8
6*	0.112	*3.2135	*0.7248	*5.5393	*9.4776	*33.9	*7.7	*58.4	31.8
7	0.112	4.0682	0.8485	5.8880	10.8047	37.7	7.9	54.4	32.8
8	0.112	4.1512	0.8599	5.7905	10.8016	38.4	8.0	53.6	32.9
9	0.056	2.1726	0.4051	3.0165	5.5942	38.9	7.2	53.9	27.9
10	0.056	2.0371	0.4691	3.1980	5.7042	35.7	8.2	51.6	26.5
11	0.056	1.8306	0.4405	3.0512	5.3223	34.4	8.3	57.3	26.1
12	0.028	1.0418	0.2376	1.7158	2.9952	34.8	7.9	57.3	24.2
13	....	0.1174	0.3906		0.5080	23.1	76.9		14.7
14	....	0.0444	0.3702		0.4146	10.7	89.3		14.8

*One of the ears in pot No. 6 was eaten up by sparrows. The nets mentioned in the previous paper in the description of arrangements for the experiments were not in use in 1883 when these experiments were made.

NUTRITION OF SUGAR BEETS AND OTHER PLANTS WITH NITROGEN.

The experiments with other plants, as beets, mustard, etc., are conducted in the same manner as those with barley. In those with sugar beets grown in the mixture of sand and peat the nitrogen content of the peat, after purification with hydrochloric acid as above described, is very small and need not affect the amount of nutritive solutions to be added. The experiments in this direction, however, are not yet complete.

In a series of these experiments with sugar beets it is well that the amounts of nitrogen be gradually diminished as in the barley series above. Such quantities of nitrogen as the following are appropriate:

No. 1	300 c. c. solution containing 4.200 grams N.
No. 2	240 c. c. solution containing 3.360 grams N.
No. 3	180 c. c. solution containing 2.520 grams N.
No. 4	120 c. c. solution containing 1.680 grams N.
No. 5	60 c. c. solution containing 0.840 gram N.
No. 6	0 c. c. solution containing 0.000 gram N.

If the 300 c. c. of nutritive solution is made up of different nitrates, as is often the case (for example 175 c. c. of a solution of calcium nitrate and 125 c. c. of potassium nitrate), it is best to dilute them both in the same proportion. The other forms of plant food are allowed to remain the same, that is to say, they are not diluted, so that the plants have a larger excess of all the other kinds of food except nitrogen.

EXPERIMENTS ON THE ACTION OF POTASH.

It is scarcely necessary to remove nitrogen and phosphoric acid from the sand used in these experiments, since both occur only in very small quantities. It is, however, absolutely necessary that the potash be

removed as the sand is found, after a time, to contain soluble compounds of potassium. The process of removal is by treatment of the sand with hydrochloric acid of a specific gravity of 1.124.

One hundred kilograms of the sand is sifted through a 0.5 mm. sieve into 33 kg. of the acid, which just covers the sand. After standing for five days the acid is removed from the sand by means of a glass siphon. The end of the siphon introduced into the sand is covered with fine silk gauze, and the other end is drawn to a very fine opening, in this way about two thirds of the acid may be removed. The sand is next freed from the excess of hydrochloric acid by washing with aqueduct water, and finally washed with distilled water until there is no further reaction with chlorine, and then dried. Sand purified in this way is found to have peculiarities which hinder the development of plants; at least the efforts at the station to grow perfectly normal plants in it, lupines and peas in particular, have not yet been successful. Exhaustive researches have been undertaken to find a remedy for this difficulty, but as yet there is nothing definite to report.

PHOSPHORIC ACID EXPERIMENTS.

No special preparation of the sand is necessary for conducting these experiments. The sand is practically free from phosphoric acid, and may be purified by washing with hydrochloric acid. The peat is purified in the same manner as for the nitrogen experiments.

ABSTRACTS OF PUBLICATIONS OF THE AGRICULTURAL EXPERIMENT STATIONS IN THE UNITED STATES.

BOTANY.

WALTER H. EVANS, *Editor.*

A new factor in economic agriculture, A. SCHNEIDER (*Illinois Sta. Bul. No. 29, Dec., 1893, pp. 301–320, plates 3*).—The author gives a brief historical review of the subject of fixation of nitrogen by the bacteria in the root tubercles of legumes and other plants and discusses their symbiotic relations. The object of the author's experiments was to grow the *Rhizobia* in a suitable medium, and by successively transferring from a leguminous medium to a gramineous one to develop *Rhizobia* capable of inoculating corn.

The culture medium was prepared as follows: Two aqueous extracts were made from *Melilotus alba*, one from the rootlets and tubercles and the other from the upper portions of stems and leaves. They were prepared by being carefully washed, chopped, and put in a jar with distilled water. This was allowed to stand in a cool place for twenty-four hours, being shaken occasionally. The juice was strained and 10 grams of agar added. After standing for twelve hours the whole was heated nearly to the boiling point until the agar was dissolved. It was then filtered through a coarse filter paper. To portions of this filtered media were added peptones, pancreatin, and salt in various proportions. Some neutral and slightly alkaline media were made by the addition of sodium carbonate solution, the normal extracts being acid in their reaction.

Fully formed root tubercles from *Melilotus alba* were taken and test tubes with the culture media inoculated from their cut surfaces. In four or five days a whitish growth was noted in most of the tubes containing the extract of the *Melilotus* roots. The tubes containing the acid medium of stems and leaves showed no development of any kind for eight or ten days, when a small growth was noticed in several of them. In each case different species of *Rhizobium* were noted, and it became evident that it was impracticable to secure a pure culture of *Rhizobium mutabile*, the species desired.

Next an attempt was made to secure a pure culture from the garden bean, but here the same difficulty was found. Cultures were made of *Rhizobia* from bean tubercles, and they readily grew upon bean agar extracts and also upon mixtures of corn and bean agar extracts. The *Rhizobia* were passed through a series of culture media of various percentages and finally were developed upon pure corn root agar extract. One month from the time cultures were begun upon the pure corn extract inoculations were made upon corn and oat plants which had been grown indoors. Inoculations were made by pouring portions of the liquid over the soil containing the sprouted plants. After twenty days the roots were washed and examined. No tubercles were visible. Slight differences were noted between the inoculated plants and those not inoculated. A microscopic examination showed that some of the inoculated corn plants were infected by *Rhizobium frankii majus*, but the infection was by no means general. No change whatever was noticed in the oat plants.

The results here given are only preliminary and are far from being conclusive, but the author claims that—

(1) *Rhizobia* of *Leguminosæ* are capable of being sufficiently modified to develop to a certain extent in root cells of corn (*Zea mays*).

(2) Presence of modified *Rhizobia* produces increased nutritive changes in corn.

(3) Presence of modified *Rhizobia* (modified in corn root agar extract) has no visible effect upon oats (*Avena sativa*).

The bulletin concludes with a very elaborate bibliography of the most important treatises upon the subject of *Rhizobia* and symbiosis.

Structure of the wheat grain, C. E. BESSEY and E. HYATT (*Nebraska Sta. Bul. No. 32, Feb., 1894, pp. 100–110, figs. 15*).—A description of the structure of the wheat grain illustrated by 15 figures. The following is the authors' summary:

The wheat grain consists of the following parts:

(1) The outer skin (*pericarp*), which is the coarsest part of the bran.

(2) An inner double skin (*episperm*), also a constituent of the coarse bran and not readily separated from it.

(3) A third, thin, and transparent, but hard, skin (*perisperm*), containing no nutritious matter whatever.

(4) A gluten layer, which is made up of cells closely filled with a very nutritious substance (*aleurone*), nearly all of which remains in the bran. In "graham bread" and "bran bread" much of this is saved and used as human food, but commonly our domestic animals get the whole benefit of it.

(5) The great mass of flour (*starch cells*), composing the bulk of the grain; but even of this a considerable portion adjoining the gluten layer is lost in the bran.

(6) The germ (*embryo*), composed of cells rich in nutritious matter. This, however, is usually separated from the flour, and finds its way to the bran and middlings.

The structure and composition of wheat bran, C. E. BESSEY and E. HYATT (*Nebraska Sta. Bul. No. 32, Feb., 1894, pp. 110–114, fig. 1*).—An illustrated description of the structure of wheat bran and quoted analyses of whole wheat, wheat flour, and wheat bran.

METEOROLOGY.

W. H. BEAL, *Editor.*

The relations of meteorology to the agricultural interests of Idaho, J. E. BONEBRIGHT (*Idaho Sta. Bul. No. 5, Oct., 1893, pp. 10*).—Some general remarks on the history and practical benefits of meteorological observations, with descriptive notes on a few of the more common meteorological instruments.

Meteorological observations at the New Mexico Station, H. H. GRIFFIN and W. GILMORE (*New Mexico Sta. Bul. No. 11, Oct., 1893, pp. 19–30*).—A record of observations on temperature, pressure of the air, relative humidity, wind movement, cloudiness, precipitation, and soil temperatures during the year ending July 31, 1893, is given in notes and tables.

Meteorological summary for North Carolina for December, 1893, H. B. BATTLE, C. F. VON HERRMANN, and R. NUNN (*North Carolina Sta. Bul. No. 93d, Dec. 30, 1893, pp. 18, maps 2*).—Notes on the weather and tabulated daily and monthly summaries of observations by the State weather service coöperating with the U. S. Weather Bureau.

WATER—SOILS.

W. H. BEAL, *Editor.*

Water analyses, G. L. HOLTER (*Oklahoma Sta. Bul. No. 7, July, 1893, pp. 39–48*).—Analyses, with reference to fitness for domestic purposes, of 46 samples of well, spring, and river water from different localities in Payne County, Okla., are tabulated and discussed.

The composition of native and cultivated soils, and the effect of continuous cultivation upon their fertility, H. SNYDER (*Minnesota Sta. Bul. No. 30, Dec., 1893, pp. 163–191*).

Synopsis.—An exam nation of about 150 samples of soils with corresponding subsoils from cultivated and uncultivated areas in five different sections of the State showed that continued grain cropping of these soils without manure has resulted in a decrease of all of their fertilizing constituents, but especially of their humus, involving a diminution of the content of nitrogen and of assimilable phosphoric acid always associated with humus in the soil, and materially lessening their power of retaining water. Rotations including sod crops and the use of well-prepared farm manures are recommended as means of renovation.

During 1892 and 1893 chemical analyses were made of about 150 samples of cultivated and uncultivated soils of Minnesota, sent in mainly by farmers of the State, although some were received from the students of the Minnesota School of Agriculture, while a few were taken

by the members of the station staff. In all cases the soils were taken according to uniform directions sent out from the station laboratory.

"Analyses have been made of both the top and the subsoil in all cases; the top soil has been taken down to a depth of about 9 inches, or until a change in the color between the soil and subsoil was observed."

The results are classified and discussed under the following heads: Red River Valley soils, including special mention of alkali soils, "gumbo" soils, and marshy and peaty soils; western and central prairie soils; northern central soils; northeastern Minnesota soils, with special notice of the soils of the station; and southeastern Minnesota soils.

The most important of the soils examined are those of the Red River Valley and western and central prairie regions, and a review of the composition of these soils in their native and cultivated state will illustrate the changes which the soils of Minnesota in general have undergone under cultivation. The soils of the Red River Valley are very deep, black, and fertile. They are sticky when wet and crumble to a fine powder when dry. The particles of which they are composed are all less than one fortieth of an inch in diameter. In their native state they are rich in organic matter, and contain from 0.35 to 0.4 per cent of nitrogen, while the soils which had been under continuous cultivation from twelve to fifteen years contained only 0.2 to 0.3 per cent of nitrogen.

The effects of the humus on the capacity of the soil to retain its water and withstand the evil effects of drought are marked. The native soils will retain about 20 per cent more water than the long-cultivated soils, and will not dry out as readily during droughty seasons as the older and long-cultivated soils. Another important point: When the humus is taken out of the native soils during the process of analysis, from 0.06 to 0.08 per cent of phosphoric acid is soluble and associated with it, while only about 0.02 per cent is in this form with the long-cultivated soils.

The soils of this region contain about 0. 5 per cent of potash (soluble in hydrochloric acid) and are well supplied with lime and magnesia, especially in the subsoil, which usually contains from 20 to 30 per cent of lime and magnesia carbonates. "It is partly to the abundance of lime in these soils that they owe their remarkable fertility."

Analyses show a noticeable decrease of phosphates, potash, and particularly nitrogen, under cultivation. The use of mineral fertilizers has not resulted in any marked increase of yield, due to the fact that they did not supply the humus needed.

The continual cropping of these soils is not telling so heavily on the mineral matters as it is on the humus that is in the soil, and with the loss of humus follows the decrease in nitrogen, the capacity of the soil to retain its water and withstand drought, and finally in the loss of the phosphoric acid in available forms.

Throughout this region small spots of alkali soils are occasionally found. Deep plowing and thorough drainage, together with heavy manuring with well-rotted barnyard manure, have given good results in correcting the alkali.

"Gumbo" soils is a popular term applied to a certain class of heavy soils also found in this region. They are "waxy" when wet and allow water to percolate through with much difficulty. The particles which compose them are very fine, less than one hundredth of an inch in size, and there is no true sand present. They are rich in alkaline compounds, particularly potassium salts. Applications of lime do not benefit such soils. Deep cultivation is recommended.

Along the water courses are areas of soils unusually rich in organic matter. "They are easily reclaimed on account of the large amount of lime that is present that prevents the formation of 'sour mold.'" The tables show that the top soils from these districts contain, on an average, about 0.5 per cent of potash, 2½ per cent of lime, and 0.34 per cent of phosphates and nitrogen, together with larger amounts of silica, alumina, etc.

The prairie soils of the western central portion of the State differ quite materially in the way in which the plant food is stored up as compared with the soils from the Red River Valley. The soil particles are a little larger and there is more silica in the form of sand. The most general type met with is a black prairie soil, 1 foot to 3 feet deep, resting on a layer of yellow clay. These soils are well supplied with lime, though not so rich in this substance as those in the Red River Valley. They are, however, richer than the latter in phosphates, humus, and nitrogen in the top soils, and both potash and lime are abundant in the subsoils. The humus is, however, being reduced by continuous cropping in the same way as with the Red River soils.

Gypsum has proven unusually beneficial to these soils. The experiments conducted in the laboratory have shown that small amounts of gypsum were quite active in rendering potash, phosphoric acid, and even nitrogen soluble in the soil water. * * *

The association of the phosphates and the humus in these soils is marked. In the native soils from 0.05 to 0.06 per cent of phosphates is associated with the humus, while only 0.01 to 0.02 per cent is present in that form in the continuously grain-cultivated soils.

Analyses of samples of typical soils from the other regions of the State are tabulated and the results discussed, with suggestions as to the management of the soils. The changes which they have undergone under cultivation are shown to be substantially the same as in the case of the Red River Valley and prairie soils already noted.

The following general summary of results of these investigations is given:

(1) The continued cropping of soils with grain crops only, without any system of rotation or other treatment, is telling severely upon the original stock of half-decomposed animal and vegetable matters and nitrogen. Soils which have produced grain crops exclusively for ten or fifteen years contain from a third to a half less humus and nitrogen than adjoining soils that have never been plowed.

(2) Soils which have been cropped until the organic matters and humus have been materially decreased retain less water and dry out more readily than when there is a larger amount of organic matter present in the soil.

(3) Soils which are rich in humus contain a larger amount of phosphates associated with them in available forms than the soils that are poor in humus.

(4) Soils which are rich in humus and organic matters produce a larger amount of carbon dioxide that acts as a solvent upon the soil particles and aids the roots in procuring food.

(5) One half of a sandy knoll heavily manured with well-rotted manure contained nearly a quarter more water during a six weeks' drought than the other half that received no manure.

(6) The supply of organic matter in the soil must be kept up because it takes such an important part, indirectly, in keeping up the fertility of the soil. A good system of rotation, including sod crops and well-prepared farm manures, will do this, and will avoid the introduction and use of commercial fertilizers which are now costing the farmers of the United States over $35,000,000 annually. It will not do to wait until this question forces itself upon us.

(7) A rotation of crops will soon be necessary on account of the peculiar composition of some of the soils and the corresponding subsoils, especially those in which the surface soils are richer in phosphates and nitrogen while the subsoils are richer in potash and lime. By means of rotation the full benefits of the strong points of both the top soils and the subsoil will be secured.

Soil temperatures, H. H. GRIFFIN and W. GILMORE (*New Mexico Sta. Bul. No. 11, Oct., 1893, pp. 25, 27*).—This includes summaries of observations on soil temperatures at depths of from 1 to 24 inches for each month of the year ending July 31, and for each day of July, 1893.

FERTILIZERS.

W. H. BEAL, *Editor.*

The true value of green manuring, J. KÜHN (*Massachusetts Hatch Sta. Special Bul., Jan., 1894, pp. 15*).—This is a translation and condensation by E. W. Allen, of an article which originally appeared in *Ztschr. landw. Cent. Ver. Sachsen, 1893, No. 1, pp. 3–13; No. 3, pp. 95–101; No. 4, pp. 117–128.* The history of the practice of green manuring is reviewed and the bearing of recent investigations and discoveries on the subject is discussed, the conclusion being reached that green crops can be more economically used in the production of meat, milk, etc., than as green manures. The gist of the author's views on this important subject is thus given in the concluding paragraphs of the bulletin:

The matter resolves itself into this, that the search for a profitable crop for green manuring the better classes of soils is without avail. The distinction should be borne in mind between green manuring—the plowing under of green plants—and plowing under the stubble and remains of a crop. The latter is necessary, and often results in much good to the land. But it is a mistake to plow into the soil for manure a pound of vegetable albuminoids which could be used for making milk or meat.

Green manuring, except with lupines on light sandy soils, marks no progress in farm management. Let us then take advantage of these recent discoveries of agricultural science, not to "manure the soil with atmospheric nitrogen," but to produce and to utilize to the fullest extent the nitrogenous and carbonaceous materials derived from the air by feeding them to farm animals.

Review of the fertilizer market (*Connecticut State Sta. Report for 1893, pp. 65–71*).—This is for the ten months ending November 1, 1893,

and gives the wholesale prices in New York and retail prices in Connecticut of nitrogen, phosphoric acid, and potash in the different forms in which they appear in the market.

Tables are given which facilitate the finding of the cost per pound of the three elements from the market quotations, and show "the fluctuations in the wholesale prices of a number of fertilizing materials in the New York market since January, 1890."

Analyses of commercial fertilizers at the Kentucky Station, M. A. SCOVELL (*Kentucky Sta. Bul. No. 48, Jan., 1894, pp. 4*).—Analyses of 14 commercial fertilizers are tabulated.

Inspection and analysis of commercial fertilizers in Louisiana, W. C. STUBBS (*Louisiana Stas. Bul. No. 23, 2d ser., Nov., 1893, pp. 750–778*).—The text of the State fertilizer law is given with comments, and the nature and source of the commercial supplies of the phosphoric acid, potash, and nitrogen of fertilizers are discussed. Remarks are made on valuation, a list of the fertilizer manufacturers and dealers complying with the law during the season of 1892–'93 is given, and analyses are tabulated of 93 samples of fertilizer materials, including acid phosphates, cotton-seed meal, tankage, bone meal, natural phosphates, fish scrap, dried blood, sulphate of ammonia, nitrate of soda, kainit, sulphate of potash, muriate of potash, phosphate of ammonia, phosphate of potash, cotton-hull ashes, ashes, land plaster, moss refuse, bat manure, marl, and Dr. Null's Plant Tonic, besides samples of limestone and iron ore.

Inspection and analysis of fertilizers in Maryland, H. B. McDONNELL (*Maryland Sta. Bul. No. 24, Feb., 1894, pp. 22*).—Extracts from the State laws regarding the taking and sending of samples, a schedule of trade values of fertilizing materials with notes on valuations, and tabulated analyses and valuations of 191 samples of fertilizing materials, including bones and other commercial fertilizers.

Analyses of fertilizers in New York (*New York Sta. Bul. No. 66, n. ser., Jan., 1894, pp. 159–181*).—A schedule of trade values of fertilizing ingredients in 1892 and 1893, and tabulated analyses and valuations of 130 samples of commercial fertilizers collected during the fall of 1893, accompanied by guaranties.

Fertilizer inspection and analysis in North Carolina, H. B. BATTLE (*North Carolina Sta. Bul. No. 95, Jan. 12, 1894, pp. 23–52*).—The bulletin is devoted to an account of the operations of the fertilizer control station during 1893, including a digest of the State fertilizer laws; notes on the manufacture of fertilizers, on the nature and sources of the various ingredients of fertilizers, on the adulteration of fertilizers, and on the necessity for accurate sampling; explanation of terms; a statement of the conditions under which analyses are made for farmers; a schedule of trade values of fertilizing materials, with directions for calculating the values of fertilizers; freight rates from the seaboard to interior points, and tabulated analyses and valuations of 262 samples of commercial fertilizers, accompanied by guaranties.

FIELD CROPS.

J. F. DUGGAR, *Editor*

Notes on cañaigre, A. E. BLOUNT (*New Mexico Sta. Bul. No. 11, Oct., 1893, pp. 17-19*).—About 10 acres of dry drift and sandy mesa soil was planted to one and two year old roots of cañaigre (*Rumex hymenosepalus*). The plants made their growth from the last of October to May, dying at the latter date without forming seed.

On the first of June examination showed that every plant made at least double, and sometimes six times, the weight of the root planted, and that cañaigre can be planted quite thickly without any inconvenience. * * *

The results obtained on adobe soils subject to regular irrigations are quite different and much more encouraging. * * * Not only have roots planted at the same time as those of the mesa increased fourfold, but nearly all produced seed, and their growth has been much larger and higher, and they have retained their life above ground much longer. * * * A plant dug up at random last month [September] had seven new roots the weight of which was two pounds and four ounces, beside the old one, and a half ounce of good vital seed was taken from the seedstalk. * * *

It would be best to plant them not less than two by two feet each way. With the present knowledge we have they should be planted in adobe soils, in rows two feet apart, in the fall, and after they are up in the spring they should be cultivated like other crops.

Detasseling corn, G. C. WATSON (*New York Cornell Sta. Bul. No. 61, Dec., 1893, pp. 312-316*).—On plat 1 the tassels were removed from alternate rows, and the gain from removing tassels was 12.4 per cent. On plat 3 the tassels were also removed from alternate rows, and the gain from removing tassels was 13 per cent. On plat 2 the tassels were left only on every fourth row, and the gain from removing tassels was 30.3 per cent.

Experiments in detasseling corn during four years at this station gave the following results: In 1890 a gain in total yield of corn of 50.6 per cent, in 1891 a very slight gain, in 1892 a gain of 21 per cent, and in 1893 an average gain of 19.3 per cent.

Tests of fertilizers on corn, D. O. NOURSE (*Virginia Sta. Bul. No. 31, Aug., 1893, pp. 113-116*).—The results of experiments on 23 duplicate plats with muriate of potash, nitrate of soda, and dissolved boneblack, singly and in combination, and at different rates per acre, are tabulated and discussed. Throughout the series the application of phosphoric acid resulted in an increased yield and in a larger proportion of corn fodder than when other fertilizers were used. In no case where nitrogen was used was the gain sufficient to cover the cost of fertilizer.

Experiments with corn and cotton, A. J. BONDURANT (*Alabama College Sta. Bul. No. 52, Jan., 1894, pp. 7*).—A test of 17 varieties of corn, an experiment in the fractional application of fertilizers for cotton,

and a test of 17 varieties of cotton. The soil for the corn plats was not uniform. Cocke Prolific gave the largest yield—22.8 bushels per acre.

In the fertilizer experiment on cotton all of the plats received just before planting 200 pounds per acre of a complete fertilizer. Two hundred pounds of cotton-seed meal was applied to one plat June 22. June 22 and July 7 cotton-seed meal at the rate of 100 and 200 pounds per acre and nitrate of soda at the rate of 50 and 100 pounds were applied to different plats. The single application of 200 pounds of cotton-seed meal per acre gave practically the same yield as the fractional application of the same amount.

Among the 17 varieties of cotton tested the largest yield of lint—474 pounds per acre—was made by one plat of Peerless; next in order of yield were W. A. Cook and Wonderful.

Final report on tobacco grown in 1892 with different fertilizers, S. W. JOHNSON (*Connecticut State Sta. Report for 1893, pp. 112–127*).

Synopsis.—The results of an examination of the fermented leaves grown in a previous experiment. The notes of experts relating to the quality of the different lots are given; also tabulated data on the fire-holding capacity of the different lots and a discussion of the effect of fertilizers on the quality of tobacco. There was no marked difference either in quantity or quality of the crops resulting from the use of cotton-seed meal and of castor pomace. Increasing the dose of either of the above fertilizers increased the yield and improved the quality of the crop. The substitution of nitrate of soda for a part of the organic nitrogen resulted in the production of inferior tobacco.

This is a continuation of the work on tobacco reported in the Annual Report of the station for 1892 (E. S. R., vol. IV, pp. 907–910). Tobacco grown in 1892 on plats differently fertilized was packed in cases on December 7 and 8, 1892. The cases were opened September 2, 1893. During this time the loss in weight varied from 12.4 to 15 per cent, averaging 13.8 per cent. Samples were examined by a committee of three experts, and the notes on the quality of the various lots of tobacco are given.

All the tobacco had a slight rawness or want of finish when handled. This, with a defect in burning quality, a slight tendency "to coal," was ascribed to the fact that new ground was used for the experiment. A classification after fermentation ranked the samples in an order somewhat different from that assigned to the various lots before fermentation.

In addition to the experts' tests of the fire-holding capacity of each sample, a more elaborate test was made by the station, using 10 leaves, testing each leaf on both sides of the midrib, at the base, near the center, and near the tip. The average result of these 60 tests is tabulated as the average fire-holding capacity of the lot. The average fire-holding capacity of all the lots was, before fermentation, 9.6 seconds, and after fermentation 24.4 seconds. Four lots fertilized with cotton-seed meal and cotton-hull ashes averaged 1,207 pounds of wrappers

per acre; four lots fertilized with amounts of castor pomace containing the same quantities of nitrogen averaged 1,225 pounds per acre. There was no important difference in the quality of the crops resulting from the use of these two nitrogenous manures. The quantity of the crop increased and the quality improved with an increase in the amounts of these fertilizers. Different amounts of cotton-seed meal or of castor pomace in combination with a constant ration of 1,500 pounds of cotton-hull ashes per acre gave the following results:

Effect of applying to tobacco different amounts of cotton-seed meal and castor pomace.

Plat.	Kind of fertilizer.	Amount per acre.	Yield of wrappers per acre.
		Pounds.	*Pounds.*
A	Cotton-seed meal	1,500	1,120
B	......do	2,000	1,130
C	......do	2,500	1,195
D	......do	3,000	1,385
E	Castor pomace	1,980	1,110
F	......do	2,640	1,180
G	......do	3,300	1,170
H	......do	4,000	1,440

The wrappers from the two larger applications of cotton-seed meal or apple pomace were superior in quality to those from smaller applications. The advantages for heavier fertilization were a little firmer ash, a better texture, lighter color, and smaller stems. The land at the outset was not in good condition, and it is suggested that heavy fertilizing may not afford such satisfactory results after the land is brought into good heart.

The substitution of nitrate of soda for a part of the organic nitrogen resulted in the production of an inferior quality of tobacco, with coarse stems and veins and uneven and mottled colors.

"There was no striking difference in the effect of nitrate of soda, whether used in a single application at the time of first cultivation or in two applications at the first and second cultivation."

The results from the use of potash from different sources were not conclusive.

The double manure salt by itself, and also with added lime, gave a considerably larger crop than any other form of potash, and also an excellent quality of wrappers, somewhat better, indeed, than the same quantity of cotton-hull ashes.

Carbonate of potash yielded only a very small crop, 870 pounds of wrappers per acre. The yield was possibly depressed by the caustic action of the carbonate, but the quality was pronounced by the judges to be the very best of all.

Nitrate of potash yielded an extremely small crop, only 450 pounds of wrappers, and the quality was below the average. It should be said, however, that a tremendous rain just after planting may have carried a large part of the nitrogen of this plat, which was entirely in the form of nitrate, down out of the reach of the crops, so that the small yield and inferior quality may be due to deficiency of nitrogen and not to any unfavorable action of the nitrate.

Experiments in growing tobacco with different fertilizers in 1893, S. W. JOHNSON (*Connecticut State Sta. Report for 1893, pp. 128–144*).

Synopsis.—Castor pomace, cotton-seed meal, linseed meal, tobacco stems, nitrate of soda, dry fish, cotton-hull ashes, double manure salt, high-grade sulphate of potash, carbonate of potash, lime, double carbonate of potash and magnesia, unleached Canada ashes, and several brands of fertilizers in various combinations were tested on tobacco. The castor pomace plats averaged 107 pounds of unfermented leaves per acre in excess of the cotton-seed meal plats. Of the various potash salts the double sulphate of potash and magnesia produced the largest total yield and the largest yield of wrappers.

This is a continuation of an experiment conducted in 1892 and reported in the Annual Reports of the station for 1892 and 1893 (E. S. R., vol. IV, pp. 907–910; V. p. 863). The figures are based on the weight of unfermented leaves. The experiments of both years were concerned with a determination of the effect on the quantity and quality of the tobacco crop produced by (1) heavy applications of cotton-seed meal and castor pomace, each in combination with mineral fertilizers and nitrate of soda, (2) by potash from different sources, and (3) by several brands of fertilizers. In addition to the questions investigated in 1892, the scope of the experiment of 1893 was enlarged so as to embrace the effect of the following fertilizers: Linseed meal, fish, stable manure and Swift-Sure superphosphate, tobacco stems in combination with castor pomace and superphosphate, and several potassic fertilizers not tested in 1892, viz, unleached Canada ashes and double carbonate of potash and magnesia and a half ration of cotton-hull ashes. In 1893 the fertilization of each plat, from A to Q inclusive, was the same as in 1892, with the exception of plats B and P.

Plat B received 1,760 pounds of linseed meal and 1,660 pounds of cotton-hull ashes per acre; plat P, 1,500 pounds cotton-seed meal, 1,740 pounds double carbonate of potash and magnesia. The formulas on plats R to X, inclusive, on which in both years several brands of fertilizers were used, were somewhat changed. Thirteen new plats were added. The ground occupied by the new plats had not been cultivated for ten years, being, in the spring of 1893, in the same condition as were the other plats in the preceding spring.

Notes on the appearance, culture, and curing of the crops at different dates and meteorological data for the growing season are given. The kind, cost, and composition of the fertilizers used; the total weight of the barn-cured (unfermented) leaves; the weight and percentage of long wrappers, short wrappers, top leaves, and seconds; the fire-holding capacity of samples from all the plats, and the number of leaves to the pound of long wrappers and short wrappers from each plat are tabulated.

The quantity and quality of unfermented leaves produced with the most important fertilizers are briefly discussed, but a discussion of the fire-holding capacity and number of leaves to the pound is deferred till the crop has been fermented.

In 1893 the average yield was 1,559 pounds per acre, or 84.5 per cent of the average crop of the preceding year. The crop of 1893 con-

tained only 48.5 per cent of wrappers, against 66.7 per cent of wrappers in 1892. The reduced yield was mainly due to a severe drought. The new plats suffered more than the original plats.

The largest yield, 2,030 pounds per acre, was made by the plat which gave the largest yield in 1892, and which was fertilized with a commercial fertilizer in both years. The average of the three plats treated with cotton-seed meal and ashes was 1,513 pounds of sorted tobacco per acre; the plats receiving ashes and the same amount of nitrogen in the form of castor pomace averaged 1,620 pounds per acre. The difference was practically the same in both years.

The castor pomace plants yielded 97 pounds of wrappers more than the cotton-seed meal plats. In 1892 this excess was only 17 pounds.

> Where for an application of 210 pounds of nitrogen in castor pomace was substituted half that quantity of nitrogen in pomace and the other half in nitrate of soda, the yield was 70 pounds less per acre when the nitrate was applied, half at the first and half at the second cultivation, but the total yield was increased by 70 pounds per acre when the nitrate was all put on at the first cultivation, and the quantity of wrappers was increased by 165 pounds per acre.
>
> Of the various potash salts, the double sulphate of potash and magnesia produced the largest total crop, 1,745 pounds, and the largest quantity of wrappers, 940 pounds.
>
> The high-grade sulphate of potash used with lime came next in total yield, 1,710 pounds, 825 pounds of wrappers, and the high-grade sulphate used without lime ranked third, 1,610 pounds, though the quantity of wrappers from this plat was smaller than from most of the other plats on which potash salts were tested, 650 pounds. * * *
>
> All of the forms of potash which were compared with cotton-hull ashes this year gave a higher yield than the latter, excepting the new potash salt, the double carbonate of potash and magnesia.
>
> The quantities of wrappers, however, raised with either Canada ashes (on new land), carbonate of potash, or high-grade sulphate of potash, were smaller than the weight of wrappers raised on cotton-hull ashes.
>
> * * * Linseed meal yielded fully as much total crop and wrapper leaves as either cotton seed or castor pomace.

A plat fertilized with 880 pounds of dry fish, 440 pounds of nitrate of soda, 720 pounds of bone, and 300 pounds of lime per acre was exceeded in total yield by only two plats, and in yield of wrappers by only four plats.

Notes on curing tobacco, W. C. STURGIS (*Connecticut State Sta. Report for 1893, pp. 82, 83*).—One week after green tobacco was hung in a barn, temperature and relative humidity determinations were made within and without the barn. At this time the average external temperature was 57° F., and the internal temperature 54° F. The average relative humidity was 70 without and 82 within. In half an hour after opening the doors and lowest row of ventilators of the barn the temperature inside rose to within one degree of the temperature outside, and the relative humidity fell from 91 to 86. One hour after lighting fires in the flues the average temperature in the barn was 71.5° F., and the relative humidity 69.

The author concludes that "the temperature and moisture in the interior of a closed barn can be so regulated by artificial heat as to

reduce to a minimum the liability of cured tobacco to damage from fungi and other like organisms."

Test of varieties of wheat, A. C. MAGRUDER (*Oklahoma Sta. Bul. No. 8, Oct., 1893, pp. 18*).—Tabulated data for 254 varieties of wheat and notes on 6 of the most productive varieties. The varieties yielding the largest amount of grain per acre were Silver Chaff Bearded, Michigan Amber (from Kansas), Missouri, and Currell, in the order named. Mediterranean Red Chaff gave the largest yield of straw per acre, followed by Michigan Amber (from Kansas), Missouri, and Mennonite. The varieties seeded in October yielded more than those seeded in November. Of the late-seeded varieties the largest yields were made by Mennonite, Boyer, Extra Early Oakley, and Tasmanian Red, in the order named. All of the grain was light, the heaviest weight, 57.7 pounds per bushel, being made by German Amber. The yield of a plat without manure, and which is to be sown in wheat continuously without manure, is also reported.

Wheat culture by the Jethro Tull or Lois-Weedon systems, I. P. ROBERTS (*New York Cornell Sta. Bul. No. 61, Dec., 1893, pp. 307–312*).—In 1874 an experiment was begun with a modification of the Lois-Weedon system of clean culture for wheat. Each plat was 5½ feet wide. The first year of the experiment every other plat was drilled to wheat and the intervening plat cultivated. The following year the treatment was alternated. The yields made on the cultivated plats were as follows: In 1874–'75, a poor season, 10.31 bushels per acre; 1875–'76, a fair season, 35.77 bushels; 1876–'77, a superior season, 67.23 bushels; 1877–'78, a fair season, 61.42 bushels. On these narrow plats the wheat virtually occupied all of the land, so that the yield should, perhaps, be given as half of the above figures.

In 1888, on tenth-acre plats separated by strips 3½ feet wide, another experiment in the Lois-Weedon system of cultivation was begun. Plat 2 received the first year 2½ tons of well-preserved mixed horse, cow, and sheep manure, and 1½ tons of the same in each subsequent year. Plat 3 received annually 45 pounds of phosphoric acid, 15 pounds of potash, and 15 pounds of nitrogen per acre in the form of commercial fertilizers. Plat 4 was cultivated in wheat continuously without fertilizer. Plat 1 consisted of 2 subplats, on which wheat and fallow alternated. The average results for 1889–'93 were as follows: From the fallowed plat, 31.41 bushels of wheat per acre; from farmyard manure, 24.62 bushels; from commercial fertilizers, 29.01 bushels; and from the unfertilized plat sown in wheat continuously, 30.75 bushels.

Chemical investigation of seed wheat and of the wheat plant, H. SNYDER (*Minnesota Sta. Bul. No. 29, Dec., 1893, pp. 147–160*).

Synopsis.—Heavy seed wheat contained more nitrogen, phosphoric acid, and potash than light wheat. Large vigorous wheat plants contained a larger percentage of nitrogen, phosphoric acid, and potash than small sickly plants. The wheat plant took up nearly three fourths of its food from the soil before heading out.

Heavy and light seed wheat (pp. 147–149).—Twelve samples of wheat grown from the same seed but in different parts of the State, and weighing from 55 to 65 pounds per bushel, were analyzed. A bushel of the heaviest seed yielded 1.3 pounds of ash containing 0.66 pound of phosphates, while a bushel of light wheat yielded 1.15 pounds of ash containing 0.51 pound of phosphates. A bushel of the heavy wheat also contained about a quarter of a pound more nitrogen than the same amount of light wheat. An analysis of the ash of each sample is given.

Chemical composition of thrifty and sickly wheat plants (pp. 150, 151).—Nine hundred thrifty wheat plants, with straw 4 feet long and well-filled heads over 4 inches in length, gave about 3 pounds of dry matter. Nine hundred sickly plants, with straw about 2 feet long and heads 2 inches long, yielded only about 1.2 pounds of dry matter. In the same weight of dry matter of each lot there was more nitrogen, phosphoric acid, and potash in the healthy and vigorous plants than in the sickly ones, but the latter contained more silica, soda, and magnesia. In the healthy plants 87 per cent of the nitrogen was in the form of gluten, while in the others only 75 per cent of the nitrogen was present in this form.

The draft of the wheat plant upon the soil in different stages of growth (pp. 152–160).—During the seasons of 1892 and 1893 samples of spring wheat were analyzed at various stages of growth, and the results calculated to a uniform basis of 900 plants per square yard. The time was arbitrarily divided into four periods ending (1) fifty, (2) sixty-five, (3) eighty-one, and (4) one hundred and five days, respectively, from the date of seeding. At the end of fifty days the plants were 18 inches high and had stored up a little less than one half of the total dry matter required during the entire period of growth. This dry matter contained nearly three fourths of the requisite total mineral matters. At sixty-five days from seeding, the plants being fully headed out, 85 per cent of the total material supplied by the soil had been taken up. In the period from the sixty-fifth to the eighty-first day, when the plants were in the milk, there was a rapid gain in organic matter, over one third of the organic compounds of the plant being produced in this period. In the last period there was an additional gain of 10 per cent of organic matter, and no material increase in mineral matter.

In the first fifty days nearly 80 per cent of the phosphates was taken up, in the second period a small amount, and in the third period nearly all the remainder, about 15 per cent. Lime was assimilated at earlier periods than magnesia. About three fourths of the potash was found in the plants at the end of fifty days. The gain in this element was gradual and uniform during the second and third periods, and there was 6.5 per cent more potash in the plant at the end of the third period than at harvest time.

About 86 per cent of the nitrogen was taken up in the first fifty days. When the wheat was headed out, about 65 per cent of the nitrogen was in forms allied to gluten. In the third period there was a change of over 20 per cent of the nitrogen from amides to gluten.

The fiber was formed largely in the first and second periods and none was formed in the last period.

The starch was formed mainly in the second and third periods.

The ash elements were assimilated in advance of the formation of organic matter.

The following table gives the amounts of the different elements removed from the soil in a crop of 18 bushels:

Amounts of different elements removed from the soil in a crop of 18 bushels of spring wheat.

	Grain.	Straw.	Total.
	Pounds.	*Pounds.*	*Pounds.*
Total mineral matter	22.0	178.0	200.0
Silica (sand)	0.1	114.0	114.1
Potash	6.5	26.5	32.0
Soda	0.1	3.0	3.1
Lime	0.7	6.3	7.0
Magnesia	2.8	2.7	5.5
Phosphates	12.4	7.6	20.0
Chlorides	0.1	1.6	1.7
Sulphates	(2.0)	2.8	4.8
Total nitrogen	25.0	10.0	35.0

Wheat and some of its products, C. L. INGERSOLL, H. H. NICHOLSON, and F. S. JOHNSON (*Nebraska Sta. Bul. No. 32, Feb., 1894, pp. 79–99, plates 2, fig. 1*).

Synopsis.—Notes on the history and classification of wheat; statistics of wheat production in Nebraska; varieties of wheat tested at the station; directions for selecting seed and treating seed wheat for smut; and a statement of the results of the baker's gluten test of flour from 20 varieties of wheat.

The classification of wheat adopted is that of the German botanist Haeckel, and is as follows:

Wheat—Triticum.

DIVISION I.—*Ægilops.*

Species *ovata* taken as type. Found in southern Europe to Turkestan in Asia. Twelve species in all recognized.

DIVISION II.—*Sitopyrus.*

1. *Triticum monococcum.*—Found from Achaia to Mesopotamia. Cultivated in Spain, Germany, and Switzerland. The grain in the ear found from the remains at or near the homes of the Swiss lake dwellers of the stone age.
2. *Triticum sativum* (wheat)—
   - (*a*) *spelta*—The oldest grain cultivated in Egypt, Greece, and in the Roman Empire. Now only found in north of Spain. A winter grain; beardless.
   - (*b*) *dicoccum.*
   - (*c*) *tenax*—
     - (a^1) *vulgare*—Found in the Egyptian pyramids in good state of preservation. American and European varieties are said to be descended from it, but it is very doubtful.
     - (b^1) *compactum*—A dwarf variety. Supposed from Swiss lake dwellers.
     - (c^1) *turgidum*—Many varieties of English wheat, also that called *compositum.*
     - (d^1) *durum*—Flint wheat from Mediterranean region; very hard; some varieties with black beards or awns.
3. *Triticum polonicum*—Not a native of Poland, as its name seems to indicate, but more likely from Spain. Found also in Italy and in Abyssinia in Africa.

Of 39 varieties of winter wheat tested in 1891-'92 the best yields were made by Hickman Extra Early Red, Landreth, Tuscan Island, and Ironclad, in the order named. Nine varieties of spring wheat and 4 varieties of Indian wheat were tested, but the yields are not given.

A description of the aleurometer, an instrument for measuring the per cent of the gluten in flour, is given. The following table shows the results of a test of the flour of 19 varieties of wheat grown at the station:

Percentage of gluten, and baker's gluten test (with aleurometer) of varieties of wheat.

Variety.	Condition of wheat.	Percentage of gluten.	Baker's gluten test.
Landreth	Sprouted	11.20	0.300
Hickman	Good	11.33	0.383
Fultz	Sprouted	10.87	0.373
Ironclad	do	12.27	0.400
Reliable	do	11.45	0.430
Extra Early Red	Slightly musty	11.02	0.333
Genesee	Sprouted	12.88	0.466
May Red	do	10.08	0.416
Egyptian	do	12.77	0.390
Hungarian	do	12.25	0.496
Buckeye	Slightly sprouted	14.56	0.500
Nigger	Sprouted	12.84	0.483
Correll	do	20.40	0.383
Coryell	Slightly sprouted	11.16	0.450
Tuscan Island	Good	11.14	0.473
Lancaster Red	Slightly sprouted	13.10	0.516
Deitz Longberry	do	11.86	0.516
	Sprouted	14.01	0.533
Tasmanian Red	Shrunken	16.23	0.606
Sea Island			0.383
Turkey Red			0.233

The flour made from these Nebraska wheats is compared with that from British India, Russia, England, Egypt, Australia, New Zealand, California, and average samples of American winter and spring wheat.

Our flours, as examined by the chemist, show an average per cent of gluten excelled only by the flour of the Russian hard wheats, and the Correll (Nebraska) wheat flour, with its 20.40 per cent of dry gluten leads them all. * * *

The wheats showing the greater per cent of gluten and the high baking tests in their flours were not able to withstand the winter well, nor did they yield nearly so much wheat per acre.

Report of the Arkansas Valley Substation for 1892, F. A. HUNTLEY (*Colorado Sta. Report for 1892, pp. 41–53*).—Variety tests of wheat, barley, oats, potatoes, and sugar beets; and notes on farm management, sweet corn, orchard grass, hard fescue, brome grass, meadow grass, redtop, perennial rye grass, Italian rye grass, sainfoin, alsike clover, white clover, red clover, German and golden millet, cabbages, cauliflowers, eggplants, melons, onions, peas, squashes, tomatoes, apples, cherries, apricots, plums, prunes, grapes, strawberries, gooseberries, blackberries, and dewberries.

Report of the San Lois Valley Substation, M. E. BASHOR (*Colorado Sta. Report for 1892, pp. 55–60*).—Notes on shade trees, apple trees, gooseberries, strawberries, raspberries, grapes, corn, wheat, bar-

ley, oats, rye, flax, sorghum, millet, alfalfa, redtop, timothy, meadow fescue, orchard grass, large canary grass, red clover, squashes, beans, cabbages, tomatoes, onions, potatoes, peas, and sugar beets, and a variety test of potatoes.

Report of the Divide Substation, G. F. BRENINGER (*Colorado Sta. Report for 1892, pp. 61–69*).—Tests of varieties of wheat, potatoes, and peas; and notes on rye, oats, buckwheat, millet, alsike clover, Mammoth red clover, meadow fescue, redtop, timothy, brome grass, Italian rye grass, yellow oat grass, sainfoin, yellow lupine, perennial vetch, Canada field peas, corn, beans, melons, pumpkins, squashes, cabbages, apple trees, forest trees, currants, gooseberries, blackberries, strawberries, and farm management. The report also contains a test of the proper distance for planting potatoes, in which the best results were secured by planting single eyes 16 inches apart.

HORTICULTURE.

Transplanting onions, C. B. WALDRON (*North Dakota Sta. Bul. No. 12, Jan., 1894, pp. 10, figs. 7*).—Attempts to grow onions in the ordinary way at the station have generally failed. April 4 seeds of a number of varieties were sown in shallow boxes in the greenhouse. When the plants came up the average stand was about 500 to the square foot. May 23 these small onions, with a diameter slightly greater than that of an ordinary wheat straw, were transplanted to the open ground 5 inches apart in the drill. On the same date and on similar soil seed of the same varieties were sown. The rainfall from above date until June 30 was 3.62 inches, for July 2.21, and for August 2.72.

The onions were harvested September 22. At this time all of those which had been transplanted were mature, while of the others only the early pickling sorts and the Extra Early Red had thoroughly ripened. Only 5 varieties out of 26 planted made a satisfactory stand from seed. The following table gives the relative yields from the two methods of culture:

Relative yields of onions transplanted and grown from seed.

Variety.	Weight of transplanted.	Weight of nontransplanted.
Early Red	71	14½
Red Victoria	53	7
White Victoria	56½	11
Silver White Ætna	65	13
Yellow Globe Danvers	47	12

The author estimates that about 84 square feet of glass are necessary to furnish plants sufficient for 1 acre, and that the cost of transplanting an acre is about $10.

When the saving of seed is taken into account it is doubtful if the expense of growing a crop in the old way is less than by the method of transplanting. Transplanting onions produced large, regular, mature bulbs, greatly excelling the others in keeping and market qualities.

Varieties of sweet potatoes, R. H. PRICE (*Texas Sta. Bul. No. 28, Dec., 1893, pp. 329–346, figs. 25, plate 1*).—Statistics are given on the production of sweet potatoes in the State and brief notes on the origin and botany of the sweet potato, on the value of the tops as forage, and on the character of the season, together with tabular statements of the yields of 31 varieties, the chemical composition of 21 varieties, and descriptive notes for 26 varieties.

An analysis of tops showed water 84.72 per cent, ash 2.735, protein 2.42, fiber 2.32, and nitrogen-free extract 7.215. The season was unusually dry and the yield small, as shown by the following table:

Yields of varieties of sweet potatoes.

Name of variety.	Yield per acre.			Name of variety.	Yield per acre.		
	Merchantable.	Culls.	Total.		Merchantable.	Culls.	Total.
	Bushels.	*Bushels.*	*Bushels.*		*Bushels.*	*Bushels.*	*Bushels.*
Barbadoes	17.26	10.89	28.15	Peabody	82.50	16.26	105.46
Big Stem Jersey	51.90	43.37	95.27	Pumpkin Yam	46.09	29.33	75.42
Black Spanish	55.89	7.68	33.57	Red Bermuda	101.00	24.18	125.18
Bunch Yam	133.32	22.70	156.02	Red Brazilian	95.45	24.18	119.63
Delaware	37.00	30.00	67.00	Red Nansemond	43.71	8.17	51.88
Dog River	11.24	8.65	19.89	Red Nose	108.74	21.36	130.10
Early Bunch Yam	144.00	37.51	181.51	Shanghai (California)	164.23	35.53	199.76
Early Golden	79.90	18.16	98.06	Southern Queen	69.80	15.88	85.58
Extra Early Caroline	31.10	16.97	48.09	Spanish Yam	11.24	9.12	20.36
Georgia Yam	14.53	8.47	23.00	Sugar (Creole)	20.69	1.50	22.19
Gold Skin	21.79	18.87	40.66	Tennessee	40.76	28.81	69.57
Hayman	31.50	9.00	40.50	Vineless	156.45	30.87	187.32
Nansemond	122.76	42.37	165.13	Yellow Jersey	23.53	21.71	45.24
Negro Choker	107.21	15.98	123.19	Yellow Nansemond	41.26	30.60	71.86
New Jersey	42.37	7.56	49.93	Yellow Yam	57.27	7.96	65.23
Norton	46.94	7.51	24.45				

"The angle at the base of the leaf and the veins along the margin of the base vary, perhaps, least of any other botanical characters of the foliage." The author divides the varieties of sweet potatoes into three classes, according to the shape of the leaf. The varieties having round or entire leaves are Dog River, Big Stem Jersey, Pumpkin, Shanghai (California), Norton, Hayman, and Southern Queen. The varieties with shouldered leaves are Gold Skin, Delaware, Extra Early Caroline, Early Golden, Yellow Jersey, Red Brazilian, Red Bermuda, Red Nose, New Jersey, Yellow Nansemond, Negro Choker, Red Nansemond, and Peabody. The varieties with lobed leaves are Barbadoes, Sugar (Creole), Yellow Yam, Vineless (Bunch Yam and Yellow Bunch Yam), and Spanish Yam. Drawings showing the shape of the leaves of each variety are given.

Bunch Yam, Yellow Bunch Yam, and Vineless were pronounced identical, having the same botanical characteristics and tracing back to a common origin.

The Vineless has the same characters of leaf as the Yellow Yam and * * * is beyond question a great acquisition in sweet potatoes. It has a short stubby vine which seldom grows over 2½ feet long. It can be planted closer in the rows and cultivated and dug easier than the running varieties. The tubers grow in a bunch near the surface. It stood the drought better here last season than the other 30 varieties and ranked second in yield. The table quality ranked equal to the best when dug. It produces slips abundantly. The tubers are smooth and rather above the medium size.

Vegetables, fruits, and flowers, F. W. MASSEY (*North Carolina Sta. Bul. No. 94, Jan., 1894, pp. 1–19*).—Notes on 7 varieties of cabbages, 10 of melons, 17 of onions, 12 of strawberries, 7 of blackcap raspberries, and 5 of blackberries, and on garden corn, cucumbers, eggplants, lettuce, potatoes, tomatoes, grapes in the vineyard and under glass, figs, peaches, tuberoses, lilies, gladioli, hyacinths, and hardy roses. In 1893, in a greenhouse 16 by 30 feet, the yield of grapes was 350 pounds. Bordeaux mixture was successfully used to prevent peach rot. Three applications are recommended—one before the buds swell, another as soon as the blooms fall, and a third when the peaches are half grown.

Grape culture, W. B. ALWOOD (*Virginia Sta. Bul. No. 30, July, 1893, pp. 91–110, figs. 5*).—Directions for training and notes on varieties tested at the station and in an orchard at Charlottesville. The author describes and illustrates the recurved fan system common among Virginia grape growers, but which he states has not before been illustrated or described in print. Notes are given on 17 black varieties, 17 red varieties, and 18 white varieties which have been tested at the station for five year; sand on 28 black varieties, 23 red varieties, and 23 white varieties tested in an orchard at Charlottesville; together with a list of 39 of Munson's new seedlings growing at the station and 22 varieties tested for one year. The following list includes the varieties recommended for general culture:

Black varieties.—Concord, for home and market; Ives, market more especially, also home use and wine; Moore Early, home and market; Wilder, especially home use, but market also; Norton, or Cynthiana, for claret wine.

Red varieties.—Brighton, especially for home use and also market; Delaware, best early market where it can be grown, unsurpassed for home use; Gærtner, home use more especially; Wyoming Red, especially for market.

White varieties.—Duchess, home and market; Green Mountain or Winchell, home and market; Lady Washington, home and market; Niagara, especially for market.

Test of varieties of grapes, G. W. McCLUER (*Illinois Sta. Bul. No. 28, Dec., 1893, pp. 249–268*).—Notes and descriptions of 98 varieties of grapes tested, and a list of 15 varieties which failed at the station. The following varieties are recommended:

For market.—Black: Concord, Worden, and Ives seedling; red: Delaware and Lindley; white: Grein Golden, and Niagara.

For home use.—Black: Concord or Worden and Moore Early; red: Delaware, Lindley, Massasoit, and Brighton; white: Grein Golden, Elvira, Niagara, and Green Mountain.

Methods of training grapes, G. W. McCLUER (*Illinois Sta. Bul. No. 28, Dec., 1893, pp. 270–272*).—The methods tested were training (1) on a horizontal trellis, (2) on a single wire, (3) on an ordinary three-wire trellis with a roof of boards, (4) on a three-wire trellis, and (5) on stakes. The horizontal trellis was 3½ feet from the ground and was made by stretching 3 horizontal wires 1 foot apart. The roof of boards consisted of a V-shaped trough made of twelve-inch boards and forming a roof 20 inches wide. The varieties used in all systems of training were Concord, Worden, Moore Early, Ives, and Delaware. The yields of grapes were estimated.

Taking the 5 varieties as a whole they have done best on the horizontal trellis, though there has not been much difference between that and the upright three-wire trellis except with Concord.

The vines on stakes have uniformly made the poorest growth and given the smallest yield.

The grapes on the covered trellis have rotted less than those on a row beside it not covered, but it has also yielded considerably less from a failure of the fruit to set.

Grapes are more easily trained on trellises than on stakes, and as the vine does not make such a compact mass on the trellis it is much easier to get at the fruit either in spraying or harvesting.

Variety tests of strawberries and strawberry crosses, S. A. BEACH (*New York State Sta. Bul. No. 64, n. ser., Jan., 1894, pp. 24*).—Notes on 60 varieties of strawberries which fruited in 1893 for the first time at the station, and a description of the results in crossing strawberries at the station. The author's conclusions were as follows:

Michel Early and Feicht No. 2 took high rank in 1893 as early strawberries.

Townsend No. 2, Edgar Queen, Princeton Chief, and Sunny Side took high rank in 1893 as late berries.

Of the newer varieties tested in 1893, Sunny Side made the best record. * * *

Systematic breeding may be expected to give more rapid improvement of cultivated strawberries than will the introduction of chance seedlings.

Johnson Late appears to be a desirable parent for use in breeding late varieties of strawberries.

Lennig White was found to be very prepotent in transmitting the color, flavor, and shape of its fruit to its seedlings. Its seedlings generally appear to be undesirable except possibly for home use.

Dawley seedlings gave a large proportion of excellent varieties.

Sharpless seedlings gave a large proportion of excellent varieties which were noticeable on account of the vigor and productiveness of the plants and the good scarlet color and good quality of the fruits.

Sundry investigations in horticulture, L. H. BAILEY (*New York Cornell Sta. Bul. No. 61, Dec., 1893, pp. 329–350, figs. 11*).—*A new food plant* (*Stachys floridana*) (pp. 329, 330).—For two years this tuber has been grown at the station. It resembles the *Chorogi* or *Stachys sieboldii*, the tubers being somewhat larger than those of the plant last named.

The mole plant (*Euphorbia lathyris*) (pp. 331–333).—Notes on the mole plant, or caper spurge.

Orchard covers (pp. 333–337).—Experiments with vetch (*Vicia sativa*), cowpeas, field peas, and clovers as plants for protecting orchards during

the winter. Vetch sown in June or early in July covered the ground with a dense tangled mulch 2 feet deep. Ten varieties of cowpeas ripened seed and 9 varieties failed to ripen seed. The varieties which seemed best adapted to the latitude of the station were the Black and the Whippoorwill. The Black and the Clay pea from North Carolina matured seed, while the same varieties from Louisiana did not. Field peas sown August 18 covered the ground completely; sown September 20 the plants reached a height of about 6 inches. Fertilizer analyses of vetch, field peas, cowpeas, and red clover are given.

Garden docks (pp. 337, 338).—Notes on the two edible plants, spinach dock (*Rumex patientia*) and large Belleville dock (*R. acetosa*).

Labels for use in orchard and garden (pp. 339–341).—Notes on the labels used in the horticultural department of the station.

Recent varieties of tomatoes (pp. 341–343).—Notes on 24 new varieties of tomatoes.

Tomato-potato grafts (pp. 343–346).—An account is given of experiments in grafting tomato cuttings on potato stock and potato cuttings on tomato stock. The tomato on the potato bore a few tubers and a fair crop of tomatoes, all of which appeared to be normal although the tubers did not grow when planted. When the potato was grafted on the tomato the roots produced no tubers, and the tops, although they bloomed freely, produced no seed balls. Although the experiments are of interest, the author states that "there is no likelihood that any economic results will follow."

Hardy carnations (pp. 346, 347).—Of a number of varieties tested the Vienna was preferred. Hardy carnations sown March 8 went through the following winter wholly unprotected on a bald hilltop and began to bloom about the middle of June.

Shed for stratified seeds (pp. 348–350).—Directions for the construction of a shed intended to protect seed requiring a long period of germination.

Whitewashing with a spraying pump (p. 350).—The spraying pump is used to apply whitewash to greenhouse roofs, barn basements, and fences.

A potato preserver (p. 350).—An examination proved this material to be ordinary land plaster.

DISEASES OF PLANTS.

WALTER H. EVANS, *Editor.*

A grape disease, G. W. McCLUER (*Illinois Sta. Bul. No. 28, Dec., 1893, pp. 268–270*).—The author gives a report of a grape disease which he thinks possibly identical with the California vine disease described in Bulletin No. 2 of the Division of Vegetable Pathology of this

Department (E. S. R., vol. IV, p. 498). The disease was first noticed during the summer and fall of 1889 and was more abundant on Concord than other varieties. It is characterized as follows:

> The disease usually makes itself apparent about the middle of the summer. The edges of a few of the leaves, usually the older ones, are affected first. These turn yellow, then gradually die, and as the disease progresses the whole leaf and additional leaves are affected. Before the leaves are entirely dead they drop off, leaving the vine more or less bare. The blade often separates from its stock, which adheres for a time to the stem. The disease or its effects have not been noticed on the stems until after the frost has killed the leaves. This is probably due to lack of sufficient observation, since but little attention has been paid to the plants from the time of the ripening of the fruit until the fall pruning, which is usually done in November. When the fruit was picked this season in September the shoots from which the leaves had fallen as a result of the disease were still alive, and unless the disease had been very bad there was nothing in their appearance to attract attention. November 10 it was found that on all plants on which leaves were badly affected a large part of the current season's growth was dead, sometimes back to the old wood, but more often with from one to four joints at the base still alive.

The author gives a long list of varieties which had been subject to the attack and says that some plants which were badly diseased in previous years showed little or no effect of the disease during the past season.

An experiment on plum rot, H. GARMAN (*Kentucky Sta. Bul. No. 47, Dec., 1893, pp. 53–55, fig. 1*).—Report on the use of Bordeaux mixture against the brown rot of plums (*Monilia fructigena*). The trees were sprayed June 9 and July 5. Some rotting fruit was observed at the time of picking on both the sprayed and check trees, and many plums fell from both during the summer. On August 22 the fruit was gathered. From a sprayed tree 11½ pounds of fruit was taken, while from the unsprayed or check tree 6 pounds ½ ounce was taken, a difference in favor of spraying of about 48 per cent.

Orange rust of blackberries and raspberries, G. P. CLINTON (*Illinois Sta. Bul. No. 29, Dec., 1893, pp. 273–300, plates 4*).—The author gives an exhaustive account of the life history of the orange rust (*Cæoma nitens*) of the blackberry and raspberry. It is described in all its known phases and the perennial nature of the mycelium is pointed out.

Since various authors have shown the connection between different species of *Cæoma* and species of *Melampsora*, a special study was made of this fungus in order to ascertain its alternation forms. It having been suggested that possibly *Cæoma nitens* and *Puccinia peckiana* are different forms of the same fungus, trials were made to produce the æcidium phase from the *Puccinia* and the teleutospore phase from the *Cæoma*. Both forms were found upon the same host, although from entire different mycelium. The artificial cultures made were not successful, but Tranzschel is quoted* as having grown upon *Rubus saxatilis* the æcidiospores of *Cæoma nitens* and teleutospores of *Puccinia peckiana* upon the leaves of the host both when grown indoors and out.

*Hedwigia 5 (1893), p. 257.

The author's conclusions are as follows:

(1) The so-called *Cæoma nitens*, a widespread and very destructive fungus of raspberries and blackberries, has been proved to possess a perennial mycelium, which probably first gains entrance into its hosts through very young underground shoots.

(2) This mycelium, following the growing parts of the plant, in early spring, gives rise to spermagonial and soon after to æcidium stages, the function of the former being as yet unproved.

(3) The æcidiospores, by immediate germination, give rise to a more mature spore form, which is in no way connected with the original mycelium.

(4) These æcidiospores produce this form by infecting the host through the stomata of the leaves, and evidence now proves *Rubus* as the host infected, and *Puccinia peckiana* as the teleutoform thus produced.

(5) *Puccinia peckiana*, produced on the underside of leaves of raspberry and blackberry, germinates its spores in the fall, and possibly in early spring, and probably enters its hosts through young underground shoots.

(6) The two facts that the mycelium of the *Puccinia* is limited to the leaves, and that the mycelium of the *Cæoma* is found throughout the plant suggest that the mycelium of the æcidium stage has its origin from the germinating *Puccinia* spores.

A chapter on the nomenclature, distribution, list of individual host plants, and bibliography completes the bulletin.

Plant diseases: their cause and prevention, M. CRAIG (*Oregon Sta. Bul. No. 27, Dec., 1893, pp. 31, figs. 23*).—This is a popular bulletin on the cause and prevention of plant diseases. Brief notes are given on the more common diseases, together with suggestions for their prevention. The more common diseases of the following, with suggested methods for prevention, are given: Cabbage, grape, bean, currant, gooseberry, apple, pear, quince, plum, cherry, peach, strawberry, rose, celery, potato, tomato, onion, corn, and wheat.

Report of the mycologist, W. C. STURGIS (*Connecticut State Sta. Report for 1893, pp. 72–111, figs. 3*).

Synopsis.—The bulletin consists of notes on spraying for apple and pear scab, potato rot, and methods of applying Bordeaux mixture, mildew of Lima beans, treatment of grapevines under glass, quince rot, quince scab, leaf blight of celery, notes on the cause of pole sweat and stem rot of tobacco, miscellaneous notes, and a report on common fungus diseases and their treatment.

The continued dry weather was so unfavorable to fungi that many of the experiments of the year were inconclusive and unsatisfactory.

Spraying for scab of apple and pear (pp. 72, 73).—The experiments under this head were designed to test the value of winter and summer treatment for the prevention of scab fungi. The plan adopted for the experiment was the same in both cases. Portions of the orchard selected were divided into four equal parts, the first receiving during the last week in March a spray consisting of a simple solution of copper sulphate in the proportion of 1 pound to 25 gallons of water. The second plat received the same, and in addition was sprayed with Bordeaux mixture as usual during the summer. The third plat was kept as a check, receiving no treatment. The fourth received only a summer treatment with Bordeaux mixture. Violent storms in August nearly stripped the trees of fruit, making it impossible to obtain con-

clusive results. However, enough was seen to recommend the use of simple copper solution early in the spring before the buds began to swell.

Potato rot and methods of applying Bordeaux mixture (pp. 73–77).—The object of these experiments was to test the value of an apparatus for applying the mixture to potatoes on a large scale. The apparatus, which is figured and described, is a simple one and can be made at a cost not exceeding $10 or $12. With it two men can easily spray 10 or 12 acres a day, the mixture being distributed thoroughly and continuously at the average walking speed of a horse. As a demonstration of the value of Bordeaux mixture the experiments were not successful, as there was no *Phytophthora* present either in the sprayed or check vines.

Mildew of Lima beans (p. 77).—Experiments were undertaken to test the relative value of Bordeaux mixture, copper acetate, potassium sulphide, flowers of sulphur, and "par oidium." The results showed that all could be used without damage to the vines, but Bordeaux mixture gave the most promise.

Treatment of grapevines under glass (pp. 77, 78).—Early in the season *Plasmopara viticola* made its appearance on Hamburg grapes grown under glass. The vines were very full of leaves and the flowers in bud. Bordeaux mixture was applied twice, the proportion being 6 pounds of copper sulphate and 45 gallons of water, but even with this weak solution the vines were badly burned. In July the remains of the Bordeaux mixture were washed from the vines with water and the house fumigated with sulphur fumes. The result was a complete recovery of the vines and a good crop of sound fruit.

Black rot of quince (pp. 78, 79).—A study was made of the fungus *Sphæropsis malorum* to ascertain the strength of Bordeaux mixture which it is feasible to use against this disease. It was shown that a solution containing 0.03 per cent or more of copper sulphate is fatal to the rot fungus of the quince, apple, and pear. Bordeaux mixture made in proportion of 6 pounds of copper sulphate to 50 gallons of water contains 1.5 per cent of the copper salts, and would in any case be sufficiently powerful to be used against this fungus.

Scab of quince (pp. 79, 80).—The author reports the occurrence of a species of *Fusicladium* resembling the common scab fungus of the apple, *Fusicladium dendriticum*, upon a quince but was unable to determine the species with certainty. The attention of growers is called to this new trouble and Bordeaux mixture is recommended as a preventive treatment.

Leaf blight of celery (pp. 81, 82).—Tests were made of potassium sulphide solution, a dilute solution of copper sulphate, and dry sulphur upon plants. On September 8 several leaves which had been sprayed with potassium sulphide and copper sulphate solutions exhibited a copious growth of the fungus. The celery which had been dusted with

sulphur showed no signs whatever of the blight. The result is similar to that obtained the year previous. Whether the use of sulphur during the wet season would produce like results remains to be seen.

Notes on the cause of pole sweat and stem rot of tobacco (pp. 84, 85).—The author calls attention to the work of Behrens* in which he claims that the cause of the stem rot is due to *Botrytis cinerea*, and that *B. longibrachiata* and *B. cinerea* are identical. The author does not agree with this conclusion, but insists that the disease is due to *Botrytis longibrachiata*, which he has found growing parasitically on plants, causing their destruction.

With regard to pole burn the author claims that the results of Behrens' observations seem to be inconclusive; that while a *Botrytis* or some similar fungus may be essential to the pole burn the disease is largely bacterial in its nature.

Miscellaneous (pp. 85–87).—Notes are given on nematode diseases of asters, and lime and artificial manures are recommeded as fertilizers for these plants.

Rose rust and black spot of rose have proved destructive on cultivated roses, and vigorous pruning and the use of Bordeaux mixture or ammoniacal copper carbonate are recommended.

The author investigated Bordeaux mixture in order to see if there was not some means to prevent the clogging of the spraying apparatus. He found it sufficient, after slaking the lime with 6 gallons of water and stirring well, to let the milk of lime stand a few minutes and pour off only the fine slaked lime of the copper solution. The danger of clogging might also be averted by slaking the lime with almost the whole quantity of water used for the mixture, allowing it to settle and then pouring only the clear limewater into the copper solution. This method would be feasible only when the quantity of water used to slake the lime could dissolve enough of the latter to precipitate as copper hydroxide all of the copper sulphate.

Report on common fungus diseases and their treatment (pp. 88–111).—Reprint of Bulletins Nos. 111 and 115 of the station (E. S. R., vol. III, p. 846; IV, p. 658).

The report also contains notes on quince leaf miner, curing of tobacco, and aster beetles, mentioned elsewhere.

Sundry botanical investigations, G. F. ATKINSON (*New York Cornell Sta. Bul. No. 61, Dec., 1893, pp. 299–306, figs. 4*).

Synopsis.—A report of the œdema of apple trees, artificial cultures of *Melanconium fuligineum*, and powdery mildew of crucifers.

Œdema of apple trees (pp. 299–302).—During July specimens of diseased apple twigs were received, showing the soft outer tissues of the limbs in a state of decay and occupied by a fungus which resembled *Fusarium arcuatum*, which was described as it occurred on the bark of

*J. Behrens: Ztschr. Pflanzenkrank., 3 (1893), No. 2, p. 82.

Pirus malus. The sender had supposed this fungus to be the cause of the trouble and had tried the use of Bordeaux mixture after having scraped off the bark from the diseased places. Since so many of the species of the genus *Fusarium* grow only in tissues which have been injured by some other agent, fresh specimens which would represent the entire progress of the trouble were requested. From this material the peculiarities of the disease may be seen as follows:

Minute elevations appear on the surface of the branches or trunks, which gradually increase in size from one eighth to one fourth of an inch long and nearly as wide. They are usually quite close together and frequently by increasing in size become confluent, when a large number extend over quite a large surface and appear as one of very irregular form. The microscopic sections through parts of the twigs where the trouble is recent show no fungus present. Immediately beneath the periderm the young phellogen tissue at the points of the blisters is seen to be very greatly elongated radially. Besides this elongation the cells are greatly distended, until the cell walls are no longer able to stretch and because they have become so thin they break and collapse. In this dying tissue is formed a nidus for such saprophytic fungi as were in many cases present. The dropsical swelling of the tissues is of the same nature as that which sometimes occurs with tomatoes when grown under conditions which favor rapid and continuous root absorption and at the same time hinder transpiration or growth. Inquiry of the owner developed the fact that the soil in the young orchard was very fertile, well worked, and favorable for rapid root absorption and growth.

During the winter and early spring the trees had been very severely pruned, leaving only the main limbs and twigs and a few secondaries, and the new growth was cut back one third. When root absorption and growth began in the spring, there being no leaves to discharge the excess of water through transpiration, the few growing points could not dispose of the excess. Consequently the thin-walled phellogen tissue could not stand the strain.

The cause being known, the remedy suggested is that too vigorous growth should be guarded against and too severe pruning should not be indulged in.

Artificial cultures of Melanconium fuligineum (pp. 302–305).—The author sought by means of cultures to verify the suggestion in Journal of Mycology, vol. VI, p. 171 (E. S. R., vol. II, p. 749), that this fungus is generically the same as *Glœosporium fructigenum.* Plate and tube cultures on agar were unsuccessful, but sterilized bean stems proved a favorable culture medium. Threads of the fungus grew both in the tissues and upon the surface of the stem. The surface at first showed a scant downy whitish covering, with a number of ascending and procumbent threads at the advancing edge of the weft. In the center of

growth this was soon succeeded by a darkening of the fungus, brought about by a discoloration of the threads lying close to the substratum and the appearance of stroma scattered over the surface, giving it a punctiform appearance. This growth spread until the entire surface presented a blackened aspect, studded with numerous points.

Compared with cultures of the type of *Glœosporium fructigenum*, the *Melanconium fuligineum* seems to be generically distinct, as shown by the characters of its germination, growth in the agar plate, and the characters of fructification on a more solid artificial substratum-like sterilized bean stems.

Powdery mildew of crucifers (pp. 305, 306).—The author mentions finding at the station in 1893 *Oïdium balsamii* on Japanese cabbage, turnips, and Scotch kale, and in 1889 upon ruta-bagas at Auburn, Alabama. This mildew has been known as destructive in England, but as observed by the author, although very abundant on some of the hosts, it did not seem to be very injurious. The author suggests that possibly this mildew may be ultimately referred to *Erysiphe*. He found the haustoria were lobed, as has already been shown for *Erysiphe galeopsidis*, and it may be a conidial form of that fungus. In size and form the conidia of the two agree very well.

Effect of fungicides upon the germination of corn, A. S. HITCHCOCK and M. A. CARLETON (*Kansas Sta. Bul. No. 41, Dec., 1893, pp. 63–79*).—The object of the experiments detailed in this bulletin was to determine the effect upon the germinating power of seeds produced by a treatment with such chemicals as are likely to be used as fungicides. The treatment employed was that of soaking the seed for a definite period in a solution of some chemical of known strength. A comparison of the seeds of corn, wheat, pumpkin, lettuce, mustard, alfalfa, tomato, and castor bean showed practically the same effect upon all, the only difference being due to the resistant powers of the seed coats.

Consequently corn was chosen for the experiments detailed by the authors. The seed used was of an ordinary dent variety of corn. A definite number of grains was counted and placed in a solution of the chemical to be tested. After remaining for the required length of time the grains were rinsed and planted in moist sand in germinating pans, the pans being covered with glass. As a check for each experiment an equal number of grains were soaked in water the same length of time and planted alongside the others.

The chemicals used were mostly chemically pure. The strength of the solutions varied with different fungicides from 0.05 to 20 per cent.

Tabulated information is given as to the chemicals used, strength of solution, number of hours the seed were soaked, date of soaking, date of germination, and date and amount of the germination of each check. Altogether 82 chemicals were tested in various strengths, making about 400 experiments. Some of the solutions were found to effect the vitality of the seed much more than others.

The fungicides are grouped into five groups, based upon the effect which they exerted upon the seed, as follows: Group 1, germination entirely prevented; group 2, germination less than 50 per cent; group 3, germination from 50 to 80 per cent; group 4, germination from 80 to 100 per cent, but greatly retarded; and group 5, germination scarcely affected. Some of the fungicides in group 1 which entirely prevented germination were copper acetate, half strength, twenty-four hours; full strength, twenty-four hours; mercuric chloride, 0.1 per cent, twenty-four hours; 0.5 per cent, twenty-four hours; 1 per cent, twenty-four hours; 6 per cent, one, three, five, and eight hours; 6 per cent, one, three, five, and eight hours; nitric acid, 5 per cent, twenty-four hours; potassium cyanide, 5 per cent, twenty-four hours; 10 per cent, twenty-four hours; potassium nitrate, 10 per cent, ninety-six hours; sodium arseniate, 5 per cent, eight, sixteen, and twenty-four hours; 2.5 per cent, twenty-four hours; 10 per cent, five, eight, and twenty-four hours; 20 per cent, five and eight hours; and sodium ammonium phosphate, 10 per cent, twenty-four hours. Some of the fungicides of group 4 which gave a retarded germination of from 80 to 100 per cent were copper chloride, 10 per cent, twenty-four hours; copper nitrate, 10 per cent, twenty-four hours; ferric chloride, 10 per cent, twenty-four and forty-eight hours; ferrous sulphate, 10 per cent, twenty-four, forty-eight, and seventy-two hours; lead acetate, 10 per cent, twenty-four and forty-eight hours; mercuric chloride, 0.1 per cent, one, three, five, eight, and seventy-two hours; 1 per cent, one hour; nitric acid, 2 per cent, two hours; potassium cyanide, 1 per cent, one hour; 5 per cent, one and three hours; 10 per cent, one hour; sodium arsenite, 0.5 per cent, one, three, five, and eight hours; sodium sulphite, 5 per cent, twenty-four hours; 10 per cent, forty-eight hours; and zinc sulphate, 10 per cent, twenty-four and forty-eight hours. Among the fungicides of group 5 which scarcely affected germination were potassium acetate, 10 per cent, twenty-four hours; potassium cyanide, 0.5 per cent, one hour; potassium sulphide, 10 per cent, twenty-four hours; sodium acetate, 10 per cent, twenty-four and forty-eight hours; and sodium sulphate, 10 per cent, twenty-four and forty-eight hours. The effect of the fungicides upon the vitality of the seed was shown first by the germination being retarded, then by the percentage of germination being lowered, and finally by the entire prevention of germination. In general, the effect upon the seed is proportional to the time of soaking and the strength of the solution.

The authors conclude that a chemical to be of value as a fungicide must not be used in a solution of such strength as to injure the vitality of the treated seed.

A comprehensive bibliography is given of the effect of fungicides upon the germination of seed.

ENTOMOLOGY.

Aster beetles, W. C. STURGIS (*Connecticut State Sta. Report for 1893, p. 86*).—Brief notes on the occurrence of *Cantharis atrata* on the asters, causing great damage to the flower heads. The ordinary insecticides seem to be of little value in combating the attack of this insect, a better method being to shake or brush the insects into shallow pans containing kerosene.

The pear leaf blister, M. V. SLINGERLAND (*New York Cornell Sta. Bul. No. 61, Dec., 1893, pp. 317–328, figs. 5*).—In Bulletin No. 23 of the station (E. S. R., vol. II, p. 420) the disease caused by the pear leaf blister mite was described and discussed at some length. Continued investigations have resulted in the addition of new facts in the life history and methods of combating this *Phytoptus*.

In the previously mentioned bulletin the method for combating the pest was to pick the affected leaves and burn them. While experimenting to learn the effects of kerosene oil on wood it was noticed that every crevice of the wood was penetrated with surprising thoroughness, and it was at once suspected that kerosene might be used with effectiveness against this mite while in its winter quarters under the bud scales.

In 1891, 2 trees were treated with undiluted kerosene, 1 with kerosene emulsion diluted with 2½ parts of water, and 1 tree left as a check. In the spring the mites appeared abundantly on the check tree, but upon the treated ones no more than a dozen galls appeared during the season.

In September, 1892, 16 trees were selected and labeled and in March, 1893, were sprayed with kerosene emulsion diluted with from 3 to 10 parts of water, 2 trees being left as checks. On July 10 the 2 trees which had not been sprayed were badly infested. The results on the others showed that the emulsion was effective when diluted with not more than 8 parts of water.

The author concludes that the pear leaf blister can be nearly or entirely exterminated in a badly infested orchard by a single thorough spraying of the trees in winter with kerosene emulsion diluted with from 5 to 7 parts of water.

A bibliography of the insect in question completes the contribution.

Quince leaf miner, W. C. STURGIS (*Connecticut State Sta. Report for 1893, pp. 80, 81, plate 1*).—Last September the author received a number of quince leaves riddled with holes varying from one eighth to one fourth of an inch in diameter. The specimens were submitted to the Division of Entomology of this Department, and determined as the work of the quince leaf miner (*Aspidisca splendoriferella*). The adult insect is a small moth which lays its eggs in the leaves of the apple, quince, and pear. The larvæ mine between the surface of the leaf, finally cutting their way out, leaving a round hole, and migrate with their cases to

the branches of the tree, where they pass the winter. When very abundant they can be easily destroyed by scraping the cases from the trunk and main limbs, thus preventing an after crop of moths. If instead of being scraped the trees are sprayed with a strong solution of kerosene emulsion after the leaves have fallen, most of the cases will be penetrated and the inclosed moths killed.

Pests of shade and ornamental trees, H. GARMAN (*Kentucky Sta. Bul. No. 47, Dec., 1893, pp. 3–53, figs. 14*).—A popular bulletin on the injuries to which shade and ornamental trees are subject. General notes are given on the attacks by various kinds of insects and fungi and methods of treating the same are suggested. The trees most liable to attack in the locality of the station are the poplar, box-elder, black locust, and walnut, while the tulip trees, sweet gum, and sugar maple usually escape.

Spraying apparatus and formulas for insecticides are given, together with descriptions of other methods of combating insect injuries. Descriptions, life history, and means for repression are given for the following: Fall webworm (*Hyphantria cunea*), bag worm (*Thyridopteryx ephemeræformis*), catalpa sphinx (*Sphinx catalpæ*), walnut caterpillar (*Datana integerrima*), locust leaf miners (*Lithocolletis robiniella, L. ostensackenella, Gracillaria robiniella*, and *Odontota scutellaris*), locust leaf skeletonizer (*Gelechia pseudacaciella*), locust skipper (*Eudamus tityrus*), poplar defoliator (*Ichthyura inclusa*), elm borer (*Saperda tridentata*), pine bark beetle (*Tomicus calligraphus*), and maple bark louse (*Pulvinaria innumerabilis*).

Insects of 1893, T. D. A. COCKERELL (*New Mexico Sta. Bul. No. 10, Sept., 1893, pp. 16, figs. 5*).—Popular illustrated notes are given of the army worm, San José scale, cochineal insect, and cottony scale of the osage orange, and descriptive lists of miscellaneous insects.

Inspection of Paris green in Louisiana, W. C. STUBBS (*Louisiana Stas. Bul. No. 23, 2d ser., Nov., 1893, pp. 778–782*).—The text of the State law regulating the sale of Paris green is given with comments, and the method of analyses pursued at the station is described.

FOODS—ANIMAL PRODUCTION.

E. W. ALLEN, *Editor.*

One hundred American rations for dairy cows, F. W. WOLL (*Wisconsin Sta. Bul. No. 38, Jan., 1894, pp. 47*).—This bulletin is a continuation of the records of the rations fed to dairy cows by farmers. Those previously collected by this station have been published in Bulletin No. 33 of the station (E. S. R., vol. IV, p. 740). The 100 rations here published are those fed by farmers in 23 States and in Canada. The data given include the number of cows giving milk, breed, average weight of the cow, annual yield per cow, the purpose for which the cows are kept (milk, butter, or cheese), and the amounts

of the various constituents of each ration fed per animal daily. From these data a summary is given showing the amounts of digestible nutrients in each ration, and these are summarized by States. The statistics were obtained by addressing a large number of representative farmers through the mails, and selecting from the replies received 100 which were fairly complete. The full statistics for these were then supplied by additional correspondence.

In summarizing the results the author says:

Number of cows.—The hundred herds, the feeding of which we are considering in this bulletin, contained in the aggregate 2,921 cows in milk during the winter of 1893; the herds contained from 5 to 150 animals, the average number being 29 animals.

Breeds represented.—Nearly all the different breeds of milch cows found in this country are represented in the herds; the Jerseys lead, and next in number come the Holsteins, Shorthorns, Guernseys, and Ayrshires, in the order given, with single representatives of the Brown Swiss, Red Polled, and Devon cattle.

Yield of milk and butter.—Referring to the comment on these figures, we note that the average annual yields of milk and butter reported were 6,314 pounds, and 303 pounds per head, respectively; 68 farmers reported their average yields of milk and 51 those of butter. The yields range from 3,000 to 12,000 pounds of milk, and from 165 to 497 pounds of butter.

Average per cent of fat in herd milk.—The average per cent of fat in herd milk was reported by 54 farmers; the figures range between 3.5 and 6 per cent, with a general average of 4.59 per cent.

The farmers giving the average fat content of their herd milk were not always the same as those reporting the annual milk and butter product per cow, so that the average figures for these data are not directly comparable. In going over all the figures carefully it seems very likely that the average yield of butter reported is very nearly correct. While it may have been overestimated in some cases, in others no allowance was made for the milk consumed as such, so that the average may be considered about right; that is, a little more than 300 pounds of butter per year per cow. * * *

Time during which cows go dry.—As will be learned by a glance at the tables, the practice followed by the majority of farmers in regard to the drying off of cows is to give them a rest of from one to two months previous to calving. Some farmers report that they can not dry off their cows, or only with difficulty, but they are in the minority. The practice of milking up to the time of calving is strongly condemned by the best authorities; it impairs the constitutional strength of both mother and calf, and reduces the production of milk or butter during the subsequent period of lactation. * * *

Feeding stuffs used.—The list of rations given includes 3 succulent feeds, 18 coarse dry fodders, 27 concentrated feed stuffs, 6 kinds of roots and tubers, and 1 miscellaneous feed (skim milk)—in all 56 different kinds of feeds. The following list shows the number of times which the more important feeds appear in the rations:

Corn silage	64 times.	Corn meal	42 times.
Roots	13 times.	Corn-and-cob meal	14 times.
Corn fodder and stalks	35 times.	Wheat	3 times.
Mixed hay	42 times.	Oats	35 times.
Timothy hay	21 times.	Barley	13 times.
Oat straw	16 times.	Linseed meal	37 times.
Clover hay	40 times.	Cotton-seed meal	35 times.
Wheat bran	73 times.	Pea meal	6 times.
Wheat shorts	13 times.	Malt sprouts	3 times.
Wheat middlings	11 times.	Gluten meal	8 times.

Nutrients in the various rations.—As only a few rations were secured from some of the States, the average figures for each State do not offer reliable data for comparison.

[Hence the average rations for different sections have been grouped.]

Nutrients in rations for dairy cows.

	Number of rations.	Dry matter.	Digestible matter.				Nutritive ratio.
			Protein.	Carbohydrates.	Fat.	Total.	
		Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
New England States	11	24.28	2.10	13.19	0.75	16.04	1:7.1
Middle States	31	24.65	2.27	13.68	0.82	16.77	1:6.8
Central States	20	22.97	1.97	12.78	0.72	15.47	1:7.3
North Central States	21	25.79	2.08	13.79	0.68	16.55	1:7.3
Southern States	2	23.48	2.00	12.14	1.05	15.19	1:7.2
Rocky Mountain States	5	30.81	3.12	15.39	0.79	19.30	1:5.5
Pacific States	1	21.60	2.68	10.54	0.55	13.77	1:4.4
Canada	9	21.57	1.76	11.69	0.63	14.08	1:7.4

* * * Including the 28 rations previously published, and combining the New England and Middle States, the Central and North Central States, the Rocky Mountain States, and Washington, we have the following table of summary:

Summary of rations for dairy cows.

	Number of rations.	Dry matter.	Digestible matter.				Nutritive ratio.
			Protein.	Carbohydrates.	Fat.	Total.	
		Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
Eastern States	55	24.38	2.20	13.31	0.77	16.28	1:6.8
Middle States	56	24.64	2.08	13.37	0.72	16.17	1:7.2
Southern States	2	23.48	2.00	12.14	1.05	15.19	1:7.2
Western States	6	29.28	3.05	14.58	0.75	18.38	1:5.3
Canada	9	21.57	1.76	11.69	0.63	14.08	1:7.4

As will be seen, the average rations fed in the Eastern, Southern, and Middle States are very nearly identical. The Canadian rations are all lighter rations than these (with but one exception), while the nutritive ratio is slightly wider. Eight out of the nine Canadian farmers reporting give their specialty of farming as breeding.

The Western rations are greatly heavier and of a narrower nutritive ratio, owing to the large extent to which alfalfa enters into the rations. The number of rations secured from these States is too small, however, to allow of generalizations as to the system of feeding practiced there.

Combining all the above 128 rations which have been fed by successful dairy farmers and breeders in the various parts of our continent, we have the following average American ration, as it may be called:

American standard ration for dairy cows.

	Dry matter.	Digestible matter.				Nutritive ratio.
		Protein.	Carbohydrates.	Fat.	Total.	
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
Average for 128 herds	24.51	2.15	13.27	0.74	16.16	1:6.9

This ration is practically the same as the [average] one published in Bulletin No. 33 and in our Ninth Report (E. S. R., vol. v, p. 502); it is believed that it will be found

correct for our American conditions except perhaps for those of the Rocky Mountains and the Pacific States. While local conditions or the business methods of farming in some places may make a ration desirable which contains more protein than this, and has a narrower nutritive ratio as a consequence, we feel confident that in the large majority of cases its adoption will give satisfactory results, and that it is preferable to the German standard ration, so long placed before our stock feeders as the ideal one, the nutritive ratio of which is 1:5.4. It is the result of American feeding experience. The majority of our most successful dairymen feed in the way indicated by the ration, and we shall not go far amiss if we follow their example.

As the market prices of cattle foods and the local conditions vary to such a great extent with different regions it is evident that no universal "best" ration for milch cows or for any other animals can be given. It is believed, however, that any dairy farmer can easily select from the abundant material in the preceding pages a ration suited to his condition.

Experiments in feeding for milk, C. E. THORNE, J. F. HICKMAN, and F. J. FALKENBACH (*Ohio Sta. Bul. No. 50, Nov., 1893, pp. 51–68*).

Synopsis.—Two experiments are reported in comparing corn silage with field beets for milk production. Incidentally 6 pounds of corn meal was compared with the same amount of a mixture of wheat bran and linseed meal. Sixteen cows divided into four lots were used in each trial and were alternated on the beet and silage rations. In both years the cows consumed more dry matter and gave more milk and more butter fat while on beets, but the percentage of fat in the milk was not materially affected by the food. The yield of milk in proportion to the dry matter eaten was about 6 per cent larger on the silage ration. Considering the cost of growing and harvesting the two crops, the dry matter in the beets cost more than twice as much as that in the corn from which the silage was made. The cows on corn meal produced slightly more milk for the food consumed than those on bran and linseed meal. Those on the latter ration produced milk with the largest fat content; but this may have been a matter of individuality, as the grain ration was not changed.

These experiments were made to compare corn silage and field beets for milk production, and were in continuation of experiments reported in Bulletin vol. III, No. 5 (second series) of the station (E. S. R., vol. II, p. 247). In the present bulletin two separate experiments are described, made in 1891 and 1892. In each case 16 cows were selected from the station herd, 8 being registered Jerseys and 8 grades. These were divided into four lots, each lot including 2 Jerseys and 2 grades. Each year the experiments were made between January and April and included four periods of about three weeks each. Lots A and B were alternated with lots C and D, the first two lots receiving beets in the first period and silage in the second, and *vice versa*. Lots A and C received 6 pounds of corn meal and lots B and D received a mixture of 3 pounds each of wheat bran and old-process linseed meal per head daily. The grain ration remained unchanged throughout the experiment.

The silage was made from fodder corn containing from 16 to 17½ per cent of ear corn and was fed at the rate of 30 pounds per cow per day. A portion of the silage was left uneaten. Fifty pounds of beets per head were fed daily and eaten clean. In addition to the above hay was

fed *ad libitum*, and it is noted that more hay was eaten while on beets than while on silage.

The cows were milked twice and weighed daily and the milk was tested weekly by the Babcock test. The average daily yield of milk and butter fat per cow is shown in the following table:

Yield of milk and butter fat per cow per day.

Year.	Period.	Food.	Lots A and B.		Lots C and D.	
			Milk.	Butter fat.	Milk.	Butter fat.
			Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
1891	0		17.56	0.644	14.92	0.589
	I	Beets	17.50	0.616		
		Silage			14.70	0.580
	II	Silage	18.07	0.571		
		Beets			15.76	0.598
	III		17.66	0.594		
		Silage			15.07	0.610
1892	I	Silage	17.90	0.797		
		Beets			19.38	0.883
	II	Beets	18.02	0.780		
		Silage			17.30	0.800
	III	Silage	17.57	0.761		
		Beets			18.01	0.839
	IV	Beets	18.04	0.771		
		Silage			17.07	0.716

In 1891 the average yield of milk from 16 cows was 16.63 pounds per cow per day while feeding on beets, and 16.48 pounds while on silage, and in 1892 it was 18.36 pounds while on beets and 17.46 pounds while on silage, a gain of 0.15 pound of milk per cow per day for the beet ration in 1891 and 0.90 pound per day in 1892. In 1890 the increased flow of milk on the beet ration was found to average 1.34 pounds per cow per day and in 1889 0.24 pound. * * * The average total butter fat found in the milk per cow per day in 1891 was 0.607 pound while the cows fed on beets and 0.587 pound on silage, and in 1892 it was 0.818 pound on beets and 0.769 on silage. The test would have been more satisfactory had the fat determinations been made daily; but they indicate that the percentage of fat in the milk was not materially affected by the feed, but that the total quantity of fat varied approximately with the flow of milk, and this was undoubtedly increased by the beets.

The cows ate somewhat more food while on beets than while on silage. The average per cow in 1891 was 26.91 pounds of dry matter while on beets and 24.89 pounds while on silage; and in 1892, 26.48 pounds while on beets and 23.03 pounds while on silage. The yield of milk per 100 pounds of dry matter eaten was as follows:

Yield of milk per 100 pounds of dry matter eaten.

Food.	Yield of milk.	
	1891.	1892.
	Pounds.	*Pounds.*
On beet ration	62	69
On silage ration	66	76

In previous experiments the yield was:

Yield of milk per 100 pounds of dry matter eaten.

Food.	Yield of milk.	
	1889.	1890.
	Pounds.	*Pounds.*
On beet ration	59	59
On silage ration	62	60

Thus it appears that in the general average of all these experiments 100 pounds of dry matter has produced about 4 pounds, or approximately 6 per cent, more milk when the cows were feeding on silage than on beets. * * *

In every test there was a marked increase in weight when the cows were changed from silage to beets, and a marked decrease when the opposite change was made. * * *

Considering all the tests [including those in 1889 and 1890] we must conclude that a part of the increased live weight shown while feeding on beets was actual gain, but the data are not sufficient to justify an estimate of the average amount of gain. The gains in live weight have been more uniform while feeding on beets, as would be expected from the greater regularity with which the beets were eaten. * * *

In the general average of the two experiments, the cows consumed 127 pounds of food and drink per head per day while on beets and 101 pounds while on silage, a difference of 26 pounds per day. One pound of this may be accounted for in the increased flow of milk and possible gain in live weight while on beets, leaving 25 pounds to be found in the excretions.

The yield of corn fodder used for silage was at the rate of about 6,000 pounds of dry matter per acre, and the yield of beets was 15¾ tons per acre, a little more than 3,000 pounds of dry matter. As the cost of raising and harvesting the beets was greater than that of the silage corn the dry matter of the beets cost more than double that of the corn.

At this difference of cost our experiments plainly show that beets can not be used with economy as a considerable part of a feeding ration. If they are to be used with profit it must be in small quantity and for the purpose of securing their effect as appetizers.

It must be remembered, however, that these experiments have been made in a region where corn is at its best, but which is considerably south of the latitude best adapted to beets. It is quite probable, therefore, that in more northerly regions the use of beets as compared with silage will be found relatively more profitable than is shown in these tests.

Corn meal vs. bran and linseed meal (pp. 66–68).—Incidentally a comparison was made of a ration of 6 pounds of corn meal per day and one consisting of a mixture of 3 pounds each of bran and old-process linseed meal. In the two years the cows receiving corn meal produced 69 and 75 pounds of milk, respectively, per 100 pounds of dry matter in the food; and those on bran and linseed meal produced 66 and 69 pounds, respectively. The percentage of fat in the milk was from 0.3 to 0.5 per cent higher in the case of the cows receiving the mixture of bran and linseed meal. "It is possible that all the difference here shown may be due to difference in productive power of the different

cows," as the grain ration of the cows was not changed during the trial.

In the average, the cows receiving the corn meal have made the larger gain in live weight, but the difference is too small and too irregular to justify overlooking the factor of individuality.

The productive capacity of different cows, C. E. THORNE, J. F. HICKMAN, and F. J. FALKENBACH (*Ohio Sta. Bul. No. 50, Nov., 1893, pp. 68–74*).—Data as to the average live weight, number of days since last calving, consumption of dry matter, and production of milk and butter are tabulated for each of the cows used in the two experiments in feeding for milk described above.

Eighteen cows showed a gain in live weight, the average gain being 0.354 pound, or one third pound per cow per day; the butter fat production of these 18 cows averaging 3.06 pounds per 100 pounds of dry matter in the food. Twelve cows lost in live weight during the test, the average loss being 0.300 pound per day, and these cows produced an average of 3.47 pounds of butter fat for each 100 pounds of dry matter in the food. * * *

If we compare the figures giving the production of butter fat with those showing the gain or loss in live weight we shall find that as a rule the live weight increased when the production of butter fat fell below the average, and that there was a falling off in live weight when the butter fat exceeded the average. * * *

The cows received on the average 0.75 pound of crude fat per cow per day in the food, while 0.79 pound per day was found in the milk, the live weight at the same time showing an increase. In other words, more fat was found in the milk than the total quantity given in the food, thus showing that while the fat of the food may be one of the sources of the fat of the milk there must also be other sources.

The observations on these cows are compared with those made on herds of cows at the Wisconsin and New York State Stations. The authors' conclusions on this subject are as follows:

(1) When fed a ration composed of about one fifth to one fourth grains and the remainder coarse foods of good quality, our cows and those of several other stations have produced an average of about 3.2 pounds of butter fat to each 100 pounds of dry matter in the food, besides making a small gain in live weight.

(2) In general, when this rate of production of butter fat has been exceeded there has been a loss in live weight, and when the butter fat has fallen below this rate there has been a gain in live weight.

(3) Individual exceptions to this general rule show that while some cows may return a handsome profit on their food, others may be fed at an actual loss, even when both butter fat and increase of live weight are counted at full value.

Ratio between increase of live weight and production of butter fat, C. E. THORNE, J. F. HICKMAN, and F. J. FALKENBACH (*Ohio Sta. Bul. No. 50, Nov., 1893, pp. 74–84*).—The experiments on the production of milk reported above "clearly show that with the same food and under the same treatment the vital machinery of one cow may transform into butter fat an amount of fat equivalent to all that is found in the food; another may supplement this with fat previously stored up in the body; and still another may convert into butter fat other constituents of the food than its fat; while others may divert the fat of the food into the formation of body fat rather than butter fat."

For measuring the efficiency of the food or the total capacity of a cow the authors believe it necessary that some factor be found by which the increase of live weight may be compared with the production either of butter fat or total milk solids. With this end in view the results of such recent experiments in steer feeding as contain the necessary data have been compiled by the authors and are given in the following table:

Productivity of food in steer feeding.

Station.	Number of steers in test.	Age at end of test.	Gain in live weight: Per day.	Gain in live weight: Per 100 pounds dry matter fed.
		Years.	*Pounds.*	*Pounds.*
Massachusetts	7	1	1.36	9.24
	7	2	1.45	7.65
New York State	5	1½	1.27	11.29
Virginia	12	3	2.17	9.26
Ontario	6	2	1.48	11.13
Kansas	8	3	2.50	10.00
Maryland	4	3	2.78	11.60
Iowa	18	1	2.48	11.35
	18	2	3.03	9.55
Average				10.03

In the general average it appears that the increase in live weight per 100 pounds of dry matter fed to steers has been about three times as great as the production of butter fat from the same quantity and kind of feed fed to cows giving milk.

This ratio of 3 pounds increase in live weight to 1 of butter fat must be accepted as true in a general way only. We know that it requires less food to produce a pound of live weight at the beginning than at the end of the fattening period, and in general that the quantity of food required increases with the age of the animal; we know, also, that it requires less food to produce a pound of butter fat at the beginning than at the end of the period of lactation; we know that there is an increased tendency to substitute flesh production for production of butter fat as lactation progresses, but we do not know the ratio in which this substitution takes place.

[From summaries of data obtained in experiments at the Wisconsin and Ohio stations] it appears that in the case of these young and still growing cows there was an almost exact compensation between the fluctuations in butter fat production and live weight increase, on the hypothesis that 3 pounds of increase in live weight may take the place of 1 pound production of butter fat; but the older cows, used in the Wisconsin and Ohio tests, manifest a loss of productiveness of butter fat as lactation progresses, which is not fully compensated by the increase in live weight, as reckoned on this basis. * * *

The foregoing study of experimental data shows that very great differences may exist between the ability of different animals to utilize the food given them in the production of butter fat or increase of live weight.

It justifies the expectation, however, that when more complete and perfect data are obtained it will be found that these forms of productive energy may replace each other under a general average ratio of about 3 pounds of increase in live weight to 1 pound in yield of butter fat.

It indicates that this ratio may be temporarily modified by age, by advancement in lactation, or in fattening, and by breed; but that the average increase in live weight over the entire period of fattening and the average production of butter fat

through entire periods of lactation, as well as the average gain or loss in live weight during lactation, may be compared upon this basis with a relatively small margin of error.

A study of the data for the cows in the dairy test at the World's Fair leads to the following statement:

The superior productiveness of individual cows employed in the World's Fair test at Chicago demonstrates the possibility of achieving a great increase in average productiveness through intelligent selection and better feeding.

DAIRYING.

E. W. Allen, *Editor.*

Investigations relating to the manufacture of cheese, part IV, L. L. Van Slyke (*New York State Sta. Bul. No. 65, n. ser., Jan., 1894, pp. 25–158*).

Synopsis.—A summary is given of the results of some 250 experiments in cheese-making covering two years—1892 and 1893—including data as to the composition of the milk, cheese, and whey, the loss of ingredients, etc. It was found that on an average 50.52 per cent of the total solids, 91.13 per cent of the fat, and 75.72 per cent of the casein and albumen in the milk were recovered in the cheese. The loss of fat in the whey was quite independent of the fat content of the milk, but was due either to the condition of the milk or the conditions of manufacture. The loss of casein and albumen was little affected by the conditions of manufacture, but was governed chiefly by the amount of albumen in the milk, most of which passed into the whey. Very little casein was lost. The amount of green cheese made for each pound of fat in the milk ranged from 2.52 to 3.06 and averaged 2.72 pounds.

Experiments in cheese-making were begun by the station in 1891. They were continued in 1892 and 1893 at cheese factories and at the station. Eleven bulletins, aggregating nearly 700 pages, have already been published on these experiments. The experiments in 1892 were summarized in Bulletin No. 50 (n. ser.) of the station (E. S. R., vol. IV, p. 945). Accounts of work in 1893 were published in Bulletins Nos. 54, 56, 60, 61, and 62 (n. ser.) of the station (E. S. R., vol. V, pp. 85, 211, 603, 605, 689). The present bulletin summarizes the work done in 1892 and 1893.

"Our investigation has included over 250 experiments relating to the manufacture of American cheese and over 150 of these have been confined to cheese factories."

The process of cheese-making was studied in 50 cheese factories located in 8 of the largest cheese-producing counties of the State. "In this work there have been used about 750,000 pounds of milk, representing the average of not less than 5,000,000 pounds of milk and the product of over 15,000 cows. The cows were very largely natives, though there were many grades and a few thoroughbreds."

The analytical work was all done in triplicate at the station, and included 11,561 determinations in the two years.

Below is given a review of the principal data and teachings of the investigations.

Conditions of manufacture.—The following statements summarize the prevailing conditions of manufacture:

The amount of rennet extract used for 1,000 pounds of milk varied in 1892 from 2 to 6 ounces, and averaged 3½ ounces, and in 1893 from 2 to 5 ounces and averaged 3 ounces.

The temperature of the milk when the rennet was added varied in 1892 from 82° F. to 90° F. and averaged 84¼° F., and in 1893 from 80° F. to 88° F. and averaged 84½° F.

The time required for the rennet to coagulate the milk completely varied in 1892 from fourteen to forty minutes and averaged twenty-five minutes, and in 1893 from five to seventy-eight minutes and averaged thirty-two minutes.

The temperature to which the curd was heated after being cut varied in 1892 from 97° F. to 106° F. and averaged 98½° F., and in 1893 from 95° F. to 105° F. and averaged 99° F.

The time from cutting curd to drawing whey varied in 1892 from one hour and twenty-three minutes to four hours and twenty-five minutes, and averaged two hours and forty-five minutes, and in 1893 from one hour and twenty-five minutes to five hours and thirty minutes and averaged three hours and eighteen minutes.

The length of string formed on a hot iron when the whey was drawn varied in 1893 from a trace to 1¼ inches and averaged one fourth inch.

The time from drawing whey to putting curd in press varied in 1892 from one hour to four hours and forty minutes and averaged two hours and forty-two minutes, and in 1893 from forty minutes to six hours and fifteen minutes and averaged one hour and fifty-three minutes.

The length of string formed on a hot iron when the curd was put in press varied in 1893 from one half inch to 4 inches and averaged 1½ inches.

The temperature of the curd when put in press varied in 1893 from 70° F. to 90° F. and averaged 81° F.

The time consumed in the operation of cheese-making after adding rennet varied in 1893 from two hours and twelve minutes to nine hours and fifty minutes and averaged six hours.

Composition of milk during the season.—The large amount of data accumulated furnishes excellent material for studying the composition of herd milk. The data tabulated show the weekly and monthly averages of composition during the season, the average amounts of cheese solids and of whey solids in milk, and the relations of fat to casein and to casein and albumen. The following table summarizes the analyses for the two years:

Average composition of factory milk, 1892 and 1893.

	In 100 pounds of milk.				
	1892–'93.		1892.	1893.	1892–'93.
	Least.	Greatest.	Average.	Average.	Average.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Water	86.09	88.53	87.36	87.32	87.33
Total solids	11.47	13.91	12.64	12.68	12.67
Fat	3.04	4.60	3.69	3.77	3.75
Casein	1.93	3.00	2.47	2.46	2.46
Albumen	0.47	0.87	0.66	0.68	0.68
Sugar, ash, etc	5.32	6.37	5.82	5.77	5.78
Pounds of casein for 1 pound of albumen	2.60	5.58	3.74	3.62	3.66
Pounds of fat for 1 pound of casein	1.38	1.78	1.50	1.53	1.52

[In regard to the total solids in 1893], there was a constant increase in solids through April, May, and June, then a marked decrease in July, which continued through the first half of August, after which the solids increased and continued so to do during the rest of the season. * * *

Only one explanation can be found for the facts: In July the pastures commenced drying up, and this continued well into August; this condition was made worse by the activity and number of grasshoppers that came in August; add to this the effect of the warm weather and annoyance by flies and we have what is undoubtedly the true explanation of the facts observed.

* * * [About the 1st of May the cows were turned to pasture, and as a result there was] not only an increase in yield of milk but also an increase of the milk solids. Our season's work, therefore, brings out incidentally the influence of food upon the composition and yield of milk, (1) when there was a change from dry to succulent food, and (2) when there was a change from succulent back to dry food. How much influence actual lack of food had early in May and again when the pastures became dry, it is impossible to say. It would appear, then, that an abrupt change from dry to succulent food may produce the double effect of increasing not only the yield of milk, but also an actual increase of milk solids in 100 pounds of milk; and a marked change from succulent to dry food may produce, on the other hand, not only a decreased yield of milk, but also an actual decrease of milk solids in 100 pounds of milk. * * *

The fat increased in May and remained about the same during May and June; there was a slight decrease in July and then a steady increase during the rest of the season. The fat was much less affected by the dry pastures than the solids not fat. It will be seen that in August, as compared with July, there was an increase of fat, but a decrease of solids not fat. * * *

The casein increased during May and June and then decreased during July and August, after which it increased for the rest of the season. Increase of fat in milk is generally accompanied by an increase of casein; but, under the abnormal conditions prevailing in July and August, the casein actually decreased, while the fat increased. * * * This increase of fat relative to casein or decrease of casein relative to fat had the effect, necessarily, of diminishing the yield of cheese relative to the fat in the milk. The cheese-makers complained of the behavior of the cheese made at this time without understanding the cause of the difficulty. The cheese leaked fat badly and did not "stand up" well, although behaving perfectly when first made. The cheese in August contained an excess of fat, as we shall notice later. The cheese-makers were really dealing with milk which was not normal factory milk, but was like normal factory milk to which some cream had been added. * * *

[The relation of casein to albumen in the milk varied for the two years from 2.6:1 to 5.58:1.] The effect of the food and weather upon the casein and albumen was such as to decrease both in July and August, as we have previously seen; but the decrease affected the albumen more than the casein, and consequently there was an increased amount of casein relative to albumen in July and August. This fact is of importance in connection with cheese-making, since the decrease in cheese yield was not so great as it would have been had the decrease fallen upon the casein exclusively or more than upon the albumen. The facts fully confirm those secured last year, and show that the proportion of casein to albumen in milk is very variable. The fact is also demonstrated more emphatically than ever that in studying the composition of milk with reference to cheese-making, we can not be guided by the amount of casein and albumen taken together but must know the amount of casein by itself, separate from the albumen.

[The relation of fat to casein is shown in the following table:]

Relation of fat to casein in milk.

	Pounds of fat for 1 pound of casein in milk.		
	Least.	Greatest.	Average.
Season of 1892	1.38	1.74	1.50
Season of 1893:			
Stone' factory	1.41	1.65	1.54
Merry's factory	1.45	1.71	1.55
Forty-eight factories	1.38	1.78	1.52
Average for 1892-'93	....	....	1.52

In normal milk, which contained fat varying from 3.04 to 4.60 per cent, the casein varied from 1.93 to 3 per cent. The fat averaged 3.75 per cent and the casein 2.46 per cent.

In no case did the normal milk, during the two seasons, contain less than 1.38 pounds of fat for 1 pound of casein or more than 1.78 pounds of fat for 1 pound of casein. * * *

It appears from our results that in case of mixed milk of herds of cows the amount of fat seldom falls below 1.40 pounds for each pound of casein. * * * The fact has also been brought out that we can not get conclusive evidence in regard to the relation of fat to casein by comparing the milk of different herds for one week, or even for one month, but we must have the results of a season.

[Concerning the relation of fat to the total proteids], it appears from our results that, in the case of mixed milk of herds of cows, the amount of fat seldom falls below 1.10 pounds of fat for each pound of casein and albumen.

Composition of whey during the season.—The range of composition and the averages for whey were as follows:

Composition of whey.

	In 100 pounds of whey.				
	1892-'93.		1892.	1893.	1892-'93.
	Least.	Greatest.	Average.	Average.	Average.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Water	92.48	93.57	93.09	93.03	93.04
Total solids	6.43	7.52	6.91	6.97	6.96
Fat	0.23	0.55	0.34	0.38	0.36
Casein and albumen	0.65	1.07	0.84	0.84	0.84
Sugar, ash, etc	5.39	6.43	5.73	5.75	5.76

The amount of solids in whey was least in April, when the amount of solids in milk was least, and greatest in the latter part of the season, when the amount of milk solids was greatest; but the variation from month to month was small. * * *

The amount of fat in whey was greatest at the beginning and end of the season, being least in June and July. * * *

The total amount of casein, insoluble and soluble, present in the whey probably does not exceed, on an average, 0.15 pound in 100 pounds of whey. We have as yet no method for determining the amount of soluble casein in the presence of albumen, and therefore we can not now present definite data on this point.

Composition of green cheese during the season.—The following table shows the range of composition of green cheese and the averages for the two years:

Composition of green cheese.

	In 100 pounds of green cheese.				
	1892–'93.		1892.	1893.	1892–'93.
	Least.	Greatest.	Average.	Average.	Average.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Water	32.69	43.89	36.41	37.05	36.84
Total solids	56.11	67.31	63.59	62.95	63.16
Fat	30.00	36.79	34.30	33.59	33.83
Casein and albumen	20.80	26.11	24.30	23.43	23.72
Sugar, ash, etc	3.12	7.02	4.99	5.93	5.61
Pounds of fat for 1 pound of casein	1.27	1.60	1.41	1.43	1.42

The amount of fat for 1 pound of casein in cheese made from normal milk varied from 1.27 to 1.60 pounds and averaged 1.42 pounds during the seasons of 1892 and 1893. * * *

From the results of our two years' work, it appears fairly settled that, in the case of cheese made from the normal mixed milk of herds of cows, the fat seldom falls below 1.30 pounds for 1 pound of casein. * * *

The general results go to show that in cheese made from normal milk the amount of fat should never be less than 50 per cent of the cheese solids, and that cheese containing less than this proportion of fat has undoubtedly been made from skimmed milk.

Loss of milk constituents in cheese-making.—This has been calculated and summarized for each separate ingredient and for groups of ingredients, making it possible to deduce some interesting facts from the mass of data. The amount of constituents recorded in cheese-making, the complement of these data, is also considered.

The amount of constituents lost in the two years is summarized as follows:

Amount of milk constituents lost in cheese-making.

	Lost in whey for 100 pounds of milk.				
	1892–'93.		1892.	1893.	1892–'93.
	Least.	Greatest.	Average.	Average.	Average.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Water	81.41	85.41	83.73	83.64	83.67
Total solids	5.81	6.83	6.21	6.27	6.25
Fat	0.21	0.50	0.31	0.34	0.33
Casein and albumen	0.58	0.94	0.75	0.76	0.76
Sugar, ash, etc	4.71	5.86	5.15	5.17	5.16
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Solids in milk lost in whey	43.59	54.73	49.13	48.68	49.48
Fat in milk lost in whey	5.68	13,51	8.40	9.12	8.87
Casein and albumen in milk lost in whey	20.00	26.30	23.96	24.28	24.28

The proportion of milk solids lost in the whey decreased quite regularly from month to month as the season advanced. This is what we should expect since the cheese-making solids of the milk (fat and casein) increased in quantity from month to month, while the whey solids (albumen, sugar, and ash) remained quite uniform, increasing only a little as compared with the fat and casein. * * *

Taking the monthly averages, we see that the smallest proportion of fat lost was in June, and the next smallest loss was in October, when the milk contained most fat, while the largest loss occurred in April or May, when the amount of fat in milk was least. * * *

The facts all go to show that the proportion of fat lost in cheese-making is quite independent of the amount of fat in the milk. The variations that occur in loss of fat are due either to the condition of the milk or to some special conditions employed in manufacture.

[As to the casein and albumen], a careful study of our results shows that the proportion of casein and albumen lost in cheese-making is remarkably uniform and that variation of conditions of manufacture has little influence upon this loss, the chief determining cause of loss being the amount of albumen in the milk, most of which goes into the whey. * * *

The proportion of milk solids lost in the whey decreased from month to month as the season advanced, while the proportion of milk solids recovered in cheese increased. This was due to an increase of cheese-making solids (fat and casein) in the milk, since these increased from month to month with the advance of lactation, while the whey solids (albumen, sugar, etc.) remained quite uniform in amount as compared with the fat and casein.

Relation of composition of milk to yield of cheese.—The data given show that during the two seasons the amount of milk required to make 1 pound of green cheese varied from 7.6 to 11.81 and averaged 9.92 pounds, while the amount of green cheese made for each pound of fat in the milk ranged from 2.52 to 3.06 and averaged 2.72 pounds.

"The amount of milk required to make 1 pound of green cheese decreased from month to month as the season advanced, because the per cent of cheese making constituents (fat and casein) increased in the milk." For the same reason "the amount of water retained in the cheese made from 100 pounds of milk increased from month to month as the season advanced." The increased amount of fat and casein in the milk "enabled the cheese made from 100 pounds of milk to retain an increased amount of water."

The author calculated the probable yield of cheese by multiplying the percentage of fat by 1.1 and the percentage of casein by 2.5 and adding the products. The factor 1.1 for the fat is taken as the "producing power that it has when made into butter," and the factor 2.5 for the casein as the "producing power that it has when made into cheese without fat." The author found experimentally that 1 pound of prepared casein would take up sufficient water to increase its weight to 2.25 pounds, and believes that the ash taken up would increase this weight to about 2.5 pounds. "The average difference between the actual and calculated yield of cheese was 0.03 pound for 1 pound of fat in milk."

A new milk or water sterilizer, C. A. CARY (*Alabama College Sta. Bul. No. 53, Jan., 1894, pp. 10, figs. 4*).—The author describes the method of pasteurizing milk by heating it in hermetically sealed bottles, the stoppers of the bottles being held in position by a wire clamp similar to that used on beer bottles. The sterilizer consists of a metal vessel holding 4 or 6 bottles, with a false bottom to raise the bottles 1 inch above the bottom of the vessel. Bottles of one half pint or one pint capacity are used. The thoroughly cleansed bottles are filled nearly full of milk, closed, and placed in the sterilizing vessel. Cold water to the depth

of about 2 inches is placed in the sterilizer, which is then heated over an oil stove or cook stove until the water has boiled for eight to fifteen minutes. The temperature reached in the milk is said to range between 150° and 167° F. The sterilizer is then taken from the stove, covered with dry cloths, and allowed to stand for thirty or forty minutes. The bottles are removed from the sterilizer and placed on ice. The milk will remain sweet for twenty-four hours or longer.

Milk sterilized by this process may be heated to a higher temperature than in open vessels without changing its chemical composition or interfering with its taste, digestibility, or nutritive value.

This closed-bottle process is not exposed to infection after sterilization.

If it is desired to sterilize the milk so that it will keep indefinitely, the directions are to heat it on three consecutive days, raising the temperature up to 185° to 205° F. This higher temperature is attained by filling the sterilizer with water to from one third to one half the height of the milk in the bottles.

In sterilizing water it is directed to heat to 212° F. from thirty to sixty minutes. A large-sized sterilizer for the use of milk dealers is described.

STATION STATISTICS.

Fifth Annual Report of Colorado Station (*Colorado Sta. Report for 1892, pp. 70, plates 2*).—This includes brief general reports by the director, botanist and horticulturist, meteorologist and irrigation engineer, entomologist, chemist, and the superintendents in charge of the substations, together with the treasurer's report for the fiscal year ending June 30, 1892.

First Annual Report of Idaho Station (*Idaho Sta. Bul. No. 6, Jan., 1894, pp 22*).—This is for the year 1893 and includes short reports of the director, the assistant directors of each of the three substations, chemist, irrigation engineer, botanist, entomologist, and meteorologist, on the lines of work undertaken, experiments in progress, equipment of the station, etc. The treasurer's report is given for the fiscal year ending June 30, 1893, and an appendix contains a list of fruit trees at one of the substations and a list of varieties of wheat.

Fifth Annual Report of Illinois Station (*Illinois Sta. Report for 1892, pp. 14*).—This includes very brief remarks on the condition of the station, the bulletins published, new work to be undertaken, a classified statement of the work done, and the treasurer's report for the fiscal year ending June 30, 1892.

Sixth Annual Report of Illinois Station (*Illinois Sta. Report for 1893, pp. 13*).—Brief general remarks on the station, list of experiments continued and undertaken and of new work planned, and the treasurer's report for the fiscal year ending June 30, 1893.

Sixth Annual Report of Louisiana Stations (*Louisiana Stas. Report for 1893, pp. 7*).—Brief reports from each of the three stations in Louisiana, and the treasurer's report for the fiscal year ending June 30, 1893.

Sixth Annual Report of Maryland Station (*Maryland Sta. Report for 1893, pp. 97–112*).—This includes a report by the director on the work of the year, condition of the station, experiments in progress, a review of the weather report, brief reports by the chemist, horticulturist, physiologist and entomologist, and physicist of the station, and the treasurer's report for the fiscal year ending June 30, 1893.

Sixth Annual Report of Tennessee Station (*Tennessee Sta. Report for 1893, pp. 16*).—Short reports of the director, botanist, assistant chemist, horticulturist, and foreman of the farm, on the work of the year, the bulletins published, the general condition of the station, etc., and the treasurer's report for the fiscal year ending June 30, 1893.

Arrangements have been made for scientific and practical investigation during the coming year in coöperation with the State bureau of agriculture The lines of work agreed upon are those regarded both by the commissioner and the station as promising valuable assistance to the farmers of the State.

ABSTRACTS OF PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE.

Insect Life (*Division of Entomology, Insect Life, vol. VI, No. 3, Feb., 1894, pp. 207–282, figs. 6–11*).—This number contains the following articles:

The insects occurring in the foreign exhibits of the World's Columbian Exposition, C. V. Riley (pp. 213–227).—A report on the insects infesting the exhibits of grain and other edible products at the World's Fair. It includes a copy of a report made by the writer to the chief of the Agricultural Department of the Columbian Exposition, with recommendations for the treatment of infested exhibits; a list of the insects found in grain and other stored vegetable products at the World's Fair; a consideration of the economic importance of the species found; the danger of new introductions; an account of the treatment by disinfection of the infested exhibits; a list of the species affecting animal products, and of other species noticed in the forestry exhibit.

Hymenopterous parasites of the California red scale, L. O. Howard (pp. 227–236).—A consideration of six true parasites of the red scale, all of which are figured, and four species described as new.

The insect collections of the Columbian Exposition, F. H. Chittenden (pp. 236–242).—A report on the different exhibits of insects at the World's Fair.

The apiarian exhibit at the Columbian Exposition, F. Benton (pp. 242–247).

The San José scale at Charlottesville, Va., E. A. Schwarz (pp. 247–252).

The San José scale in Virginia, D. W. Coquillett (pp. 253–254).—The above two articles are reports of investigations carried on under the direction of the entomologist of damage by *Aspidiotus perniciosus* at Charlottesville, Va.

Pyralidina of the Death Valley expedition (pp. 254–255).—A short list of pyralid moths, supplementary to a report previously published in No. 7 of *North American Fauna.*

Descriptions of Pyralidæ from the Death Valley, C. H. Fernald (pp. 255–257).—Descriptions of three new species of moths of the genus *Loxostege*, one of *Titanio*, and two of *Metasia*.

Entomological memoranda for 1893, M. E. Murtfeldt (pp. 257–259).—Notes on several insects observed about St. Louis, Mo., during 1893.

A new spider parasite, W. H. Ashmead (pp. 259-260).—Account and description of *Zaglyptus kincaidii* n. sp.

Notes on Scolytidæ and their food plants, W. F. H. Blandford (pp. 260-265).—General notes on the structure, classification, and biology of the *Scolytidæ*, with particular reference to wood-boring species; special notes on several species of more or less economic importance, and description of *Xyleborus morigerus* n. sp.

Notes and correspondence.—Among the topics treated under the headings Special and General Notes, and Extracts and Notes from Correspondence, the following may be mentioned:

Quarantine against injurious insects; insects injurious to celery; spraying orchards; Syrian book worms; a cheese skipper injuring hams; leaf-hopper damage to winter grain; the Egyptian Icerya in Australia; damage by locusts in Colorado; abundance of red spider in Illinois; kerosene and animal parasites; larvæ in a child's face; road dust against swine lice; a competition in economic entomology; grain insects in sugar; potato tuber moth in California and Texas; ants and the fruit grower; kerosene emulsion against sheep ticks.

Fertilizers for cotton, J. M. McBRYDE (*Office of Experiment Stations, Farmers' Bul. No. 14, pp. 32*).—This is an account of experiments conducted during three years on the experimental farms of the South Carolina Station, condensed from Bulletin No. 2 of the South Carolina Station (E. S. R., vol. III, p. 534), with practical deductions regarding the fertilizer requirements of cotton, the selection and mixing of fertilizers, and methods of applying, drawn from the data reported.

ABSTRACTS OF REPORTS OF FOREIGN INVESTIGATIONS.

The antiseptic value of ozone, DE CHRISTMAS (*Ann. Inst. Pasteur, 7 (1893), No. 11, pp. 776–780*).—The author inoculated 10 gelatin tubes with a culture of charbon aged forty-eight hours and containing no spores. Five of these tubes were exposed to an atmosphere containing 1.5 to 2 mg. of ozone per liter, or 0.061 to 0.1 per cent by volume. Five others placed in an ordinary atmosphere were used as checks. Five days later the tubes were examined, showing no development in those in the ozonized atmosphere, but good growth in the other tubes. The same experiment was repeated with the bacilli of typhoid fever and diphtheria and with the spores of *Aspergillus niger.* As before, no growth developed in the tubes exposed to the atmosphere containing ozone while the checks developed normally. At the end of five days these tubes were placed in an oven, when it was found that all life was extinct, with the exception of *Aspergillus.*

The time required for the destruction of the charbon bacillus by an atmosphere charged with ozone in the proportions stated above formed the subject of another experiment. A culture remaining in this atmosphere for twenty-four hours was able to develop normally. When left for forty-eight hours development was retarded but not destroyed. Ninety-six hours sufficed to kill all life in the cultures used.

To test the resistance of spores to this disinfecting agent the spores of *Bacillus subtilis* dried on plates were exposed to an ozonized atmosphere until killed, and the time necessary for this result was found to be from eight to ten days. Ozone when present at the rate of 0.5 mg. per liter of air did not interfere with the development of a number of organisms exposed to its influence.

The author regards the use of ozone as a disinfecting agent for sick chambers as impracticable on account of the difficulty of obtaining ozone in the necessary quantity, and from the fact that an atmosphere sufficiently charged with ozone to destroy microörganisms is irrespirable.—J. F. D.

A study of the arable soils of the Department of Aisne, France, L. GAILLOT and P. SÉRENT (*Bul. Sta. Agron. Laon, 1893, pp. 33–277, 314–344*).—In continuation of work commenced in 1890 analyses (including determinations of nitrogen, carbonate of lime, magnesia, phosphoric acid, and potash) of samples of soils and subsoils representing 116

districts of the Department are tabulated, together with notes on the history and physical character of each of the soils examined. The geology and distribution of the soils of the Department are also discussed at some length.

The system of classification of the soils according to physical properties is explained and the proportions of nitrogen, phosphoric acid, and potash in soils of different degrees of fertility, as determined by analysis, are tabulated.

The latter are summarized in the following table:

Nitrogen, phosphoric acid, and potash in soils of different degrees of fertility.

	Nitrogen.	Phosphoric acid.	Potash.
	Per cent.	*Per cent.*	*Per cent.*
Very poor	Below 0.05	Below 0.01	Below 0.05
Poor	0.05-0.10	0.01-0.05	0.05-0.10
Medium	0.10	0.05-0.10	0.10-0.20
Rich	0.10-0.20	0.10-0.20	0 20-0.30
Very rich	Above 0.20	Above 0.20	Above 0.30

As regards lime the minimum amount considered desirable is 5 per cent in compact soils and 1 per cent in loose soils.

A soil in a good state of fertility should, therefore, contain not less than 0.1 per cent of nitrogen, 0.1 per cent of phosphoric acid, 0.2 per cent of potash, and 1 to 5 per cent of lime according to its physical condition.—W. H. B.

Nitrification in soils of meadows.—J. DUMONT and J. CROCHETELLE (*Compt. Rend., 117 (1893), No. 20, pp. 670-673*).—Numerous experiments by Boussingault and more recently by E. Bréal have shown that the soils of meadows contain only insignificant amounts of nitrates. The absence of active nitrification clearly explains the enormous reserve of nitrogenous matter which these soils contain—a fertility which is unfortunately of little benefit, since the *Gramineæ* which predominate in permanent grass lands derive especial advantage from the use of nitrates.

Thinking that perhaps the soils of meadows highly charged with organic matter do not generally present the feeble alkalinity favorable to the action of nitric ferments, the authors undertook to study the influence of different carbonates on nitrification.

In the first experiments a soil was used which had been in grass from time immemorial. It contained, per kilogram, 420 grams of lime and 68.4 grams of humus (in which there was 11 grams of organic nitrogen and 32.2 grams of combined carbon). On May 10, 1 kg. of this soil (containing 60 mg. of nitric nitrogen per 1,000 grams) was treated with variable amounts of carbonate of potassium. It was stirred and watered several times during the experiment. After one month the nitrates were extracted, with the following results: Nitric nitrogen, per 1,000 grams of soil, without addition of carbonate of potash, 70 mg.;

with 1 gram of carbonate of potash per 1,000 grams of soil, 160 mg.; with 2 grams of carbonate of potash, 230 mg.; with 3 grams, 250 mg.; with 4 grams, 130 mg., and with 5 grams, 73 mg.

In July other experiments were undertaken in which the costly carbonate of potash was replaced by sulphate and chloride of potash. In a supplementary series carbonate of soda was used. The results are shown in the following table:

Nitrogen nitrified in one month in 1,000 grams of soil receiving variable amounts of different fertilizers.

Applications.	Nitric nitrogen obtained with—			
	Carbonate of potash.	Chloride of potash.	Sulphate of potash.	Carbonate of soda.
	Mg.	*Mg.*	*Mg.*	*Mg.*
Nothing	80	80	80	80
1 gram per 1,000 grams of soil	98	75	150	80
1.5 grams per 1,000 grams of soil	98	78	180	80
2 grams per 1,000 grams of soil	140	78	220	75
2.5 grams per 1,000 grams of soil	160	100	260	75
3 grams per 1,000 grams of soil	127	100	240	73
4 grams per 1,000 grams of soil	100	78	270	75
5 grams per 1,000 grams of soil	85	80	340	70
6 grams per 1,000 grams of soil	80	78	340	75
8 grams per 1,000 grams of soil	60	78	350	73
10 grams per 1,000 grams of soil	60	78	350	70

These determinations show that the most favorable rate of application of carbonate of potash is 2.5 grams per 1,000; and that the application of 8 grams per 1,000 completely checked nitrification. The maximum amounts of nitric nitrogen were lower than those obtained in the previous experiment. This is probably due to the stirring and watering during the former experiment.

In other experiments a marshy soil which effervesced actively on the addition of acids was employed. It contained 28.7 grams of combined carbon, corresponding to 57.6 of humus, per kilogram. The amounts of nitrogen nitrified per 1,000 grams of soil from June 20 to July 10 were as follows: Without carbonate of potash, 8 mg.; with 1 gram per 1,000 grams of soil, 62 mg.; with 1.5 grams, 91 mg.; with 2 grams, 140 mg.; with 2.5 grams, 180 mg.; and with 3 grams, 105 mg. From September 21 to October 5 with applications of sulphate of potash the following amounts of nitrogen were nitrified per 1,000 grams of soil: Without sulphate of potash, 78 mg.; with 2 grams of sulphate of potash per 1,000 grams of soil, 420 mg.; with 5 grams, 456 mg.; and with 8 grams, 300 mg. It will be observed that in the last two experiments soils receiving no applications gave very different quantities of nitrates. The soil which received finely pulverized sulphate of potash had been exposed to the air several months and nitrification had doubtless gone on very actively in it, a usual result in such cases, as recently shown by the experiments of Dehérain.*

* Ann. Agron., 19 (1893), p. 401; Compt. Rend., 116 (1893), pp. 1091–1097 (E. S. R., vol. IV, p. 961).

The carbonate of potash was not as effective in the marshy soil as in the other. The difference is doubtless due to the variable amounts of humus in the two soils. In order to observe the influence of carbonate of potash on nitrification in the presence of an abundance of humus other experiments on arable soils were instituted. Two samples of such soils were collected from the grounds of the Grignon Station. One contained 29 grams of humus per kilogram, and the other, cultivated without manure since 1875, contained only 10.8 grams of humus. The following table shows the average results obtained by applications of carbonate, sulphate, and chloride of potash, at the rate of 2 grams per 1,000 grams of soil:

Nitrogen nitrified in 1,000 grams of soil in fifteen days.

Applications.	Soil rich in humus.		Soil poor in humus.	
	Total.	Excess.	Total.	Excess.
	Mg.	*Mg.*	*Mg.*	*Mg.*
Nothing	39	....	28	....
Carbonate of potash	68	29	32	4
Sulphate of potash	80	41	46	18
Chloride of potash	57	18	46	18

It will be seen that the excess of nitric nitrogen produced by the addition of salts of potash was noticeably less in the soil poor in humus.

From these experiments the following conclusions may be drawn:

(1) Nitrification in soils rich in humus was promoted by applications of small quantities of carbonate of potash (2 to 3 grams per 1,000 grams of soil), but larger amounts of the carbonate were injurious.

(2) Sulphate of potash was effective for the same purpose. Even in amounts of 7 to 8 grams per 1,000 grams of soil it favored the formation of nitrates.

(3) Chloride of potash produced only a moderate effect.

(4) Carbonate of soda did not appear to promote nitrification.

It remains to be determined by field trials what are the amounts of sulphate of potash which can be most advantageously employed in the culture of grass lands.—W. H. B.

The effect of electricity on plants grown in soils differing in composition, A. PEIFFER (*Rev. Agron., 1893, No. 3, pp. 135–142*).—The author refers briefly to the work done in electroculture by La Grange, Hervémangon, Prillieux, Siemens, Dehérain, Bailey, Fischer de Waldheim, Warner, Spechnew, Grandeau, Chadot, Le Royer, De-Puydt, and Berthelot.

The author's special aim was to discover the reason for the different results secured by the two Belgians, DeVuyst and Leplae. Both of these used currents from the zinc and copper couple, the current traversing the soil in which the roots of the plants experimented with

were growing. DeVuyst's results were negative, while Leplae secured a favorable effect from the use of electricity.

The author made his experiments in pots each containing 2 kg. of washed sand, manured with a complete fertilizer. In each series the soil of one pot was subjected to the action of a current afforded by a copper-zinc couple, while the other was not subjected to artificial electrical influence. The intensity of the current was not accurately determined, but it was found that it caused a deflection of the magnetic needle of from 1° to $1\frac{1}{4}$°, while the same plates in a 10 per cent solution of sulphuric acid caused a deviation of 31°. After lying in the soil for six weeks the couple furnished a current much more feeble than at the beginning of the experiment.

The complete manure supplied to each pot consisted of 700 mg. of nitrate of potash, 500 mg. each of phosphate of soda and sulphate of lime, and 50 mg. each of sulphate of magnesia and sulphate of iron. To ascertain the effect of the electrical current on soils varying in composition, the author added to one pot tricalcium phosphate, to another clay, to another carbonate of lime, to another black peat, to another carbonate of potash, and to another carbonate and sulphate of magnesia. The pots were exposed to the air and received necessary waterings.

Carrots and oats were the crops experimented with, and the total yields of these two crops made under the different conditions of the experiment are shown in the following table:

Effect of electricity on total yield of oats and carrots on soils of different composition.

	Oats.		Carrots.	
	Without the electric current.	With the electric current.	Without the electric current.	With the electric current.
	Grams.	*Grams.*	*Grams.*	*Grams.*
Complete manure with 20 grams of tricalcium phosphate	25	....	133	197
Complete manure with 20 grams of clay	22	20	109	52
Complete manure with 20 grams of carbonate of lime	19	18	33	30
Complete manure with 10 grams of black peat	20	151	131	205
Complete manure with 4 grams of carbonate of potash	3	....	5	....
Complete manure with 1 gram of carbonate of magnesia and ½ gram of sulphate of magnesia	65	76	....	....

The above table seems to show that the electrical current exercised a very strongly favorable action on plants grown in the pot containing peat, while its effect was injurious in the pot containing clay. Oats germinated very poorly in the pot containing an excess of magnesia and subject to the electrical current, while carrot seed under these conditions did not come up at all. Oats did not come up in the pot containing carbonate of potash and traversed by the electrical current, and under these conditions carrots came up very slowly.

To verify the experiments in which the electrical current had exercised an unfavorable influence on plants grown in a clay soil, the author repeated this experiment, planting mustard seed in pots containing 4

kg. of sand and 250 grams of clay fertilized with difficultly soluble fertilizers. For the pots thus treated the total harvest of mustard was 15 grams when the pot was not subject to electrical influence, and only 8 grams in the pot subject to the electrical current.

On three plats each 90 by 40 cm. the author made an experiment with the zinc and copper couple to determine the effect, if any, of the direction in which the electrical current was made to flow. One of these was untreated. On another the electrical current was made to flow in the same direction as the telluric current, while on the other it was made to flow in exactly the opposite direction. Turnips were planted on all three plats. On the untreated plat the yield was 8 kg. When the natural and artificial currents coincided in direction the yield was $14\frac{1}{3}$ kg.; when these currents were in exactly opposite directions the yield was only 10.5 kg.—J. F. D.

Fraud in the fertilizer trade in Brittany, G. PATUREL (*Ann. Agron.. 19 (1893), No. 24, pp. 579–593*).—Fraud in fertilizers, such as substitution of ground schists or slate for natural phosphates, the selling of the cheap unassimilable Somme phosphate as Boulogne phosphate, which is more assimilable and consequently more costly, and especially guaranteeing larger amounts of the useful elements than are actually present, furnishing animal charcoal which is partly or entirely deprived of its phosphoric acid, and charging excessive prices for guanos and phospho-guanos, have been very common in Brittany in the past.

The purchaser is protected against such fraud by the laws of France relating to fertilizers. Samples of suspected goods sent to the laboratory of the department are analyzed gratuitously and the results returned with suggestions as to the quality of the product. This system has greatly reduced the proportion of fraud. Dishonest dealers depend at present principally upon the ignorance of the farmers as to the true value of fertilizers and the needs of their soils, inducing them to make extravagant expenditures for fertilizers which give no adequate return.

The general organization of agricultural syndicates among farmers through which fertilizers and other agricultural supplies can be safely and advantageously purchased is recommended.—W. H. B.

Trifolium pannonicum, a perennial clover DENAIFFE (*Abs. in Sem. Agricol., 14 (1894), No. 666, p. 50*).—The claim is made that this clover on good soil attains a height of 1 meter, affords two cuttings a year, and is very vigorous and resistant to cold. The leaves resemble those of red clover, but they are longer and a little more hairy. The stems are taller and the flowers larger than those of red clover. The flowers are white at the top and yellowish at the base. This plant requires a deep rich soil. At first it grows very slowly, forming no plant stem during the first year of growth but only small rosettes of leaves. It is stated that 15,000 to 18,000 kg. per hectare of hay have

been cut from this plant. It is said to be relished by cattle in spite of the hairiness of the plant. The author regards the scarcity and high price of the seed as the chief obstacle to its culture.—J. F. D.

Experiments with cowpea, mung bean, soja bean, chick-pea, and horse gram, G. VALDER (*Agr. Gaz. N. S. Wales, 4 (1893), No. 11, pp. 855–858; No. 12, pp. 914–917*).—At Croydon, near Sydney, New South Wales, the above leguminous plants were planted October 8. The soil was a heavy loam, with a red clay subsoil.

Cowpea.—The following varieties of cowpea were planted: Clay, from Queensland and from the United States, Large White from South Australia, Black from Queensland and from the United States, Small White from Queensland and from New South Wales, Small Brown from Queensland, Variegated from Queensland, and Whippoorwill, from the United States.

The largest yield (37½ bushels of seed per acre) was made by the Black variety. This variety also produced the largest yield of green forage and is considered by the author the best of all the varieties tested. The average number of pods on a plant was 28, and the average number of peas in a pod 14. The long pods were well filled with very large black peas.

The next largest yield of peas (34 bushels per acre) was made by the Small White, a quick-growing variety, with leaves smaller than those of the Black. This variety yielded 41 pods to the plant, each pod averaging 11 peas. The Clay pea averaged 32 pods per plant and 15 peas per pod. The yield on one plant was 33¾ bushels, on another 30 bushels per acre.

The Large White was the earliest and most upright of all the varieties tested. This variety yielded 28½ bushels of seed per acre, and averaged 26 pods to the plant, the pods containing on an average 10 peas. The other varieties were noticeably inferior to those just mentioned.

Mung bean (Phaseolus mungo).—Sown in drills 18 inches apart and thinned to 6 inches, the different varieties matured in three to three and a half months after seeding. The Light Brown variety yielded 13 bushels of seed per acre, the Dark Green from Queensland yielded 26½ bushels, the Dark Green from India yielded 28 bushels, and the Light Green 35 bushels. The Light Green was superior to the other varieties in yield and in earliness; its grain was also larger. The plants attained a height of about 18 inches. The average number of pods on the plants of mung bean was 117, and the average number of beans in a pod was 11.

Soja bean.—Three varieties were planted, but the common white and the black soja bean, both from Queensland, were badly attacked by bean rust. The Improved White from the United States yielded 37 bushels of seed per acre. This variety averaged 235 pods or 648 seeds per plant. The soja bean was nearly five months in coming to maturity.

Chick-pea, or gram (*Cicer arietinum*).—Sown in drills 18 inches apart and thinned to 4 inches in a drill, the red-seeded variety from India yielded 27½ bushels of seed per acre and the same variety from New South Wales, 32 bushels; the white-seeded variety from England, 21 bushels. The red-seeded variety proved the hardier, earlier, and more productive. The plants of this variety attained a height of only 12 to 15 inches and a diameter of only about 6 inches. The white-seeded variety grew 18 inches high and measured about 10 inches through.

The author considers this as of no value for green manuring and for feed, as the yield of green stuff is very small in comparison with other leguminous plants. Both varieties mature in about three months from the time of seeding.

Horse gram (*Dolichos biflorus*).—The yellow and the black varieties were sown. The climbing plants attained a height of about 3 feet, but did not bloom. The yield of green forage was at the rate of 9,300 pounds per acre. As this yield was much inferior to that of the cowpea, and as horse gram occupied the land for nearly five months without seeding, the author regarded it as of little value in comparison with other leguminous plants.—J. F. D.

Cold storage of fruit, A. H. BENSON (*Agr. Gaz. N. S. Wales*, 4 (*1893*), *No. 11*, *pp. 870–877*).—The system of cold storage adopted in the author's experiments afforded a nearly even temperature, with a constant influx of cold air. The ventilation was so perfect that there was never any strong odor of fruit or any condensation of moisture on the fruit or cases. The average temperature of the room for the whole period was 41.74°. Only twice did the thermometer register less than 38° and only nine times above 45°.

Apples kept without any appreciable loss for over four months, and after being taken out of cold storage they remained sound for ten days. Among other varieties of pears which were easily kept was the Winter Nelis, which kept for over two months in perfect condition, and when removed from cold storage ripened and developed its full flavor. All the solid-fleshed varieties of plums kept well for two months, even when not wrapped. Most of the varieties of peaches kept only about two weeks without deterioration, though wrapped and packed in ventilated cases. The author concludes that only solid-fleshed clingstones can be kept in salable condition for more than a month.

Nectarines wrapped in tissue paper and packed in ventilated cases retained their flavor and kept from January 28 to March 9. Grapes kept from six to seven weeks, at which time they were still in fair order.

As materials for packing grapes, cork dust, kiln dried pine sawdust, and peat were tried. Cork dust proved the best material; kiln-dried pine sawdust imparted no objectionable flavor and answered well, the only objection to this material and to peat being their dustiness.

Mangoes and pineapples were successfully kept. Tomatoes gathered just as the fruit was beginning to show color shriveled and never

became properly colored. One sample picked a week later, when the fruit was fairly colored, kept well for a month. Cold storage proved of no value for the passion fruit.

It is stated that apples keep equally well if the temperature exceeds the average temperature of this experiment by as much as 10° but that all the other fruits require the low temperature. Before removing fruit from cold storage the temperature of the cold chamber should be raised to that of the outside air.—J. F. D.

The sixteenth technical report of the Federal Seed Control Station at Zurich, F. G. STEBLER (*Schweiz. landw. Ztschr., 21 (1893), No. 48, pp. 801–832*).—During the year from July 1, 1892, to June 30, 1893, there were examined at the station 5,958 samples of seed, requiring 16,427 separate tests. This number shows quite an increase over the previous year, indicating the growing demand for tested seed. Of the total number of samples received 2,714 were received from the cantons of Switzerland, 109 of the contributors being seed dealers and 225 consumers. From countries other than Switzerland, 3,244 samples were received from 91 dealers and 57 consumers, making a total of 482 contributors. Of the total number of samples sent for inspection, 4,893, or 81.9 per cent, were clover and grass seeds. The average condition of seed showed an improved quality over that of the previous year. Tabulated information is given of the average results of the tests made during the years 1876–'93 of 126 varieties of seed, the more important of which are here given:

Average of eighteen years' seed testing.

Kind of seed.	Purity.	Germinative ability.	Intrinsic worth.	Kind of seed.	Purity.	Germinative ability.	Intrinsic worth.
	Per cent.	*Per cent.*	*Per cent.*		*Per cent.*	*Per cent.*	*Per cent.*
Red clover	96.3	90	87.7	*Bromus mollis*	66.3	51	35.1
White clover	94.9	77	73.6	Velvet grass	70.1	44	32.3
Alsike clover	95.3	74	71.0	Peas	96.6	88	93.8
Hop clover	95.7	75	71.3	Common vetch	96.3	90	90.9
Crimson clover	96.6	84	87.3	Yellow lupine	98.6	83	80.8
Alfalfa	97.3	89	86.5	Buckwheat	98.7	76	76.7
Esparcet	97.0	76	73.8	Oats	97.7	84	85.9
Kidney vetch	90.0	35	74.9	Barley	98.4	78	87.3
French rye grass	75.1	71	54.3	Rye	93.0	90	93.8
English rye grass	95.2	77	74.8	Hemp	98.1	83	82.9
Italian rye grass	94.3	73	69.9	Flax	97.9	85	83.8
Orchard grass	77.5	78	62.1	Sugar beet	98.1	*167	*145.6
Timothy	97.9	90	88.7	Garden beet	97.4	*138	*133.5
Meadow fescue	90.7	83	76.7	Yarrow	86.1	60	55.4
Sheep fescue	78.8	65	52.1	Serradella	94.0	69	68.8
Blue grass	85.7	53	47.2	Spurry	96.6	72	68.0
Crested dogtail	90.0	66	60.3	Corn, white	96.4	84	81.8
Meadow foxtail	81.8	55	45.9	Turnips	97.2	91	89.8
Yellow oat grass	65.6	44	32.4	Carrot	85.2	47	40.1
Fiorin	74.0	85	65.4	Parsnip	89.0	23	33.8
Poa nemoralis	79.2	66	52.9	Parsley	94.0	64	73.6

*Number of plants per 100 capsules.

The station possesses for field tests three fields—one near the laboratory for the smaller tests, one at Wollishaven upon the lake shore two miles from Zurich, and the third for alpine experiments in the Alps at some distance from the station—W. H. E.

Concerning the origin of American clover seed, O. BURCHARD (*Landw. Vers. Stat., 43 (1893), No. 3 and 4, pp. 239–246*).—The necessity of knowing the climatic and other conditions under which seed is grown is becoming to be considered of great importance in agricultural practice as well as in experimental tests. It is claimed that by a study of the weed seed accompanying clover seed its origin may be ascertained. Nobbe, after twenty years of study, gives the following as the weed seeds characteristic of American clover seed: *Ambrosia artemisiæfolia*, *Plantago rugellii*, and *Panicum capillare*.

The author proposes to carry this study further and determine from what part of America the clover seed has come. He claims to be able to distinguish by the weed seed Canadian seed from that grown in the latitude of Maryland, and Atlantic States seed from more western grown.

Twenty-two lots of North American clover seed were secured through trustworthy importers. Three samples of seed were secured from Toronto, Canada; 6 from Baltimore, Maryland; 2 from Philadelphia; 3 from New York City; 1 from Saint Louis, Missouri; 2 from Chicago, Illinois; 2 from Milwaukee, Wisconsin; and 3 from Toledo, Ohio. The purity of the samples varied from 83.17 to 99.06 per cent. The percentage of admixtures and number of weed species bear no relation to one another.

The following table shows the per cent of admixtures:

Analysis of American clover seed.

Origin.	Total weight of sample.	Weight of foreign matter.	Weight of weed seed.	Number of species weed seed.	Total number of weed seed per kilogram.	Origin.	Total weight of sample.	Weight of foreign matter.	Weight of weed seed.	Number of species weed seed.	Total number of weed seed per kilogram.
	Grams	Per cent	Per cent				Grams	Per cent	Per cent		
Baltimore..	48	3.40	0.73	26	10,837	St. Louis..	99	1.58	0.38	22	4,244
Do.....	60	16.83	6.43	27	79,001	Chicago ..	143	1.17	0.15	17	2,044
Do.....	117	2.09	0.98	25	12,555	Do....	150	2.35	1.29	26	24,556
Do.....	227	4.43	2.19	27	22,077	Milwaukee	146	1.95	0.69	20	9,698
Do.....	167	2.15	0.65	28	6,030	Do....	141	1.52	0.76	22	6,290
Do.....	52	12.95	5.98	36	116,284	Toledo.....	165	1.24	0.18	19	2,959
Philadel'ia.	160	1.95	0.93	24	4,439	Do....	165	1.39	0.49	27	7,226
Do.....	38	2.76	0.71	21	9,032	Do....	180	1.85	0.21	22	3,219
New York.	137	1.51	0.19	22	3,031	Toronto ..	96	2.77	1.20	28	30,561
Do.....	51	3.48	0.73	13	17,912	Do....	114	4.99	3.19	23	29,640
Do.....	150	0.94	0.11	20	1,408	Do....	99	3.36	1.58	23	24,330

The author claims that seeds of the following weeds characterize all American clover seed: *Amarantus retroflexus*, *Ambrosia artemisiæfolia*, *Panicum filiforme*, *P. capillare*, *P. crus-galli*, *Phleum pratense*, *Plantago rugelli*, *Rumex* spp., *Setaria glauca*, *S. viridis*, *Trifolium hybridum*, and *T. repens*. He finds further that *Cnicus arvense*, *Echinospernum deflexum*, and *Melandrium album* are characteristic admixtures of Canadian seed, while *Euphorbia maculata*, *Lepidum virginicum*, *Origanum vulgare*, *Plantago aristata*, *Panicum sanguinale*, *Phacelia* sp., *Verbena urticæfolia*,

an undetermined species of *Caryophyllaceæ*, and probably *Cuscuta racemosa* are charateristic of that from the Eastern or Atlantic States. The seed from the Western States has not been sufficiently studied, and as yet the author does not consider it as definitely characterized by any of the species of weed seed it contains.

[The author seems to have no assurance that the seed secured from Baltimore was grown in Maryland or that the seed from Chicago was grown in Illinois, but assumes that each lot was grown in the region from which it was evidently exported. The doubtful determination of *Phacelia tanacetifolia* in Maryland-grown seed is evidently wrong, as that species is only accredited to California. The reporting of the seed of *Rumex acetosa* in every sample but one is surely an error of determination, as *R. acetosa* is a rare plant, introduced sparingly from Europe, and, according to a recent monograph on the genus, is only found in three places in the United States].—W. H. E.

A new enemy of the potato (Hydrœcia misasea), H. CLAUSEN, (*Landw. Wochenbl. Schles. Holst., 43 (1893), No. 50, pp. 520–521, fig. 1*).—The author gives a popular account of the appearance during the past summer of a stalk borer of the potato. The larva enters the stalk at or near the ground, eating its way upward into the stem or downward into the roots, causing the destruction of the plant. The mature butterfly is described as 32 to 40 mm. across the wings, and of a clear reddish brown or copper color, with darker bordered spots. The larva is common on *Glyceria* spp., *Atriplex* spp., *Carex arenaria*, *Iris*, reeds, and the roots of *Petasites officinalis.* It seems likely to become destructive to the potato. No means are suggested for its repression.—W. H. E.

Researches on the nematodes of sugar beets, L. GAILLOT and P. SERENT (*Bul. Sta. Agr. Laon, 1893, pp. 348–350*).—The report shows the necessity of early seeding where nematodes are known to be in the soil. Two lots of sugar-beet seed were planted early in April and watered to insure growth. One lot was planted in the same kind of soil two months later and given the same treatment. The first two lots responded vigorously to the treatment, and although their roots were covered with the nematodes gave a good yield. The late planted seed developed poorly. The leaves did not exceed 10 cm. in height and the root development was very poor, the roots being literally destroyed by the nematodes, and no crop was harvested. The explanation is that the difference is due to climatic reasons, the temperature in April being less favorable for nematodes, but still not too cold for the growth of the beets.

The authors advise early seeding in nematode-infested soils, and the use of fertilizers readily assimilated, such as nitrate of soda, salts of potash, and superphosphate, which will give the plant sufficient force to resist attacks of nematodes later in the season.

Experiments are cited of M. Willot on the use of the condensation water from gas works for the destruction of nematodes, in which he obtained excellent results. The ammonia of these waters is a strong

fertilizer and at the same time some of the other elements are active nematocides, but in agricultural practice the authors think this means hardly practicable. Carbon bisulphide is also mentioned as a probable means of destroying nematodes.

The authors recommend (1) the burning of all waste products and application of the ash to the soil; (2) that the vehicles used for the transportation of sugar beets should be entirely free from refuse; (3) that alfalfa should be used as an alternate crop with sugar beets; (4) that nematode-infested soils designed for sugar-beet culture should receive winter cultivation, which will destroy a large number of the cysts and at the same time be of advantage from a cultural point of view; (5) that these soils, independent of other fertilizers, should receive mineral fertilizers rich in nitrogen, potash, and soluble phosphoric acid early in the spring; and (6) that the seeding should be done at the earliest possible time.

A review of the synonymy and statements regarding the proposed future study of nematode diseases of rye are also given.—W. H. E.

Composition, impurities, and adulteration of linseed meal and linseed cake, J. VAN DEN BERGHE (*Contr. Lab. Agri. Provincial, Roulers., pp. 28, plates 24*).—The author calls attention to the foreign materials often found in linseed meal and linseed cake, some of which are very injurious to stock, while other admixtures serve only to decrease the feeding value of the meal. The author has made many analyses of linseed meal and cake and found that many of the samples, claimed to be pure, contained foreign seed and other material. The principal foreign seed found were as follows: *Sinapis arvensis*, *S. nigra*, *Lychnis githago*, *Polygonum convolvulus*, *P. lapathifolium*, *Spergula arvensis*, *Cerastium triviale*, and *Chenopodium polyspermum*. In lesser quantities were found *Chenopodium album*, *C. glaucum*, *Camelina dentata*, *Centaurea cyanus*, *Galium aparine*, *Lolium arvense*, *Phleum pratense*, and *Setaria glauca*. Of this list only the mixtures containing seed of *Sinapis* and *Lychnis* are dangerous. These should not be fed, owing to their physiological effects. The mustards contain a principle, myrosin, that is exceedingly irritating if taken in considerable quantity. Cases are cited of fatal results following the feeding of oil cake containing considerable mustard seed to milch cows. The seeds of the corn cockle contain saponine, an acrid irritant capable of causing nervous disorders and dysentery.

Different authors are quoted showing the extent to which linseed is contaminated by the presence of weed seed. Nobbe has found 41 species of weed seed in the product of the Province of Pernau. Voelcher found in Bombay flaxseed 4.5 per cent of weed seed, and in seed from the Black Sea 12 to 20 per cent. Morskenski has found in seed from Odessa impurities varying from 3 to 70 per cent.

The author claims—and in this he agrees with many others—that a chemical analysis alone is not sufficient for recognizing some of the

admixtures, and suggests that it should always be supplemented by a microscopical examination. Most of the seeds have characteristic cell structure of the integuments or of starch grains, whereby they may be recognized. The microscopic appearance of the epidermis, pericarp, and starch grains of the more common admixtures are described and figured. Directions are given for the preparation of opaque material for examination and for the other microscopical technique necessary for such a study.

It is said that the farmers of Flanders prefer linseed cake to colza cake for their stock, as being more nutritious and digestible. It is considered better for rearing and fattening stock, while colza is preferred for milch cows on account of its favoring milk production. The following analyses are given of the two, whereby they may be compared:

Comparative analyses of linseed and colza cake.

	Water.	Protein.	Fat.	Resinous material.	Nitrogen-free extract.	Fiber.	Ash.
Linseed cake	12.60	32.37	13.81	0.47	27.91	6.28	6.56
Colza cake	10.94	35.13	9.35	6.28	22.11	9.95	6.24

In the linseed cake 53 per cent of the crude protein was soluble in water, while only 15 per cent of that in the colza was soluble. Of the nitrogen-free extract of linseed, 61 per cent was soluble in water and 31 of that in colza.

Tabular information is given of the variation in protein and fat found by the analyses made during fourteen years. The maximum protein was 37.50, and the minimum 24.24; and for fat the maxima and minima were 13.63 and 6.04 per cent, respectively.

The adulteration or sophistication of linseed cake and meal is accomplished (1) by adding mineral material, as sulphate of baryta, sulphate of lime, sand, or ferruginous soil; (2) by adding meal of less value, as rape, colza, peanut, hemp, castor bean, and poppy; or (3) by adding waste products, as peanut shells, rice hulls, bean hulls, buckwheat hulls, etc. Notes are given on the physiological effect of these admixtures upon stock, and citations showing the fatal effect following the feeding of such mixtures. The bulletin concludes with a chapter on the production of the oil of mustard in crucifers, including a table showing the percentage contained in all the leading species.—W. H. E.

Poisoning of cattle by feeding cake adulterated with castor bean, POLLET, LACOMBE, and LESCOEUR (*Jour. Pharm. et Chim., 28 (1893), No. 12, pp. 538–545*).—Two pregnant cows were fed on rape cake of good quality with no effect on the quantity or quality of the milk, though the butter had a somewhat peculiar flavor. May 26, 1893, each cow received rape cake containing castor-bean pomace. On the 27th and

28th the temperature of one cow rose to 39.6° C., a bloody diarrhea set in, and the yield of milk fell from 11 to 5 liters per day. This animal had recovered by June 6, when the adulterated cake was again given, followed by the same disturbances as before. Apparently the health of the other cow was scarcely affected by the first dose of adulterated cake, but on June 1 this cow lost her fetus of four months. A feed of adulterated cake given June 2 induced fever and slight diarrhea. By June 7 both animals were greatly emaciated and showed staring coats and dull eyes. The milk, after a brief period of depression, quickly increased, but did not reach the original amount. The quality continued normal, as shown by daily analyses.

The authors call special attention to the abortive property of castor pomace, which it is believed has not been noticed before. In addition to the above cases, they knew of instances where the accidental use of cake containing castor bean was followed by abortion.

Rape cake may be examined for the presence of castor bean either with or without the microscope. A mechanical separation is effected by means of a current of water, the pulp being first washed away and then the portions of the seed coat of rape, while the seed coat of the castor bean remains in the residue. In a microscopic examination the seeds of castor bean show a collection of cells containing small masses of oil and granules quite similar in form and dimension to starch grains. These, however, are altered by water. The seed coats of castor bean furnish marked characteristics. The outer membrane shows a network of polygonal cells, some colored and others colorless. The inner membrane is marked by a great number of spiral ducts. A cross section of the woody membrane shows elongated pigment cells arranged in palisades and quite different from those of the rape seed.

If examined chemically castor bean may be detected by the solubility of its oil in alcohol, while rape seed oil is quite insoluble. Rape-seed oil is devoid of rotary power, while castor oil rotates yellow light toward the right. In the same way, an alcoholic extract of rape oil showed no rotary power, while a similar extract of castor oil showed a decided rotary power in the polariscope.—J. F. D.

Grains of Paradise as an adúlterant of black pepper, T. F. HANAUSEK (*Chem. Ztg., 17 (1893), No. 96, pp. 1765–1769, figs. 4*).—The seed known in commerce as grains of Paradise, Guinea pepper, Meleguetta pepper, etc., is derived from a plant belonging to the order *Zingiberaceæ* and genus *Amomum.* While one species furnishes the true seed it is very probable that several others differ so little as to be readily substituted for the genuine. The author gives an elaborate synonymy and history of the species. These seed are being largely used to adulterate black pepper, especially when ground, and a microscopical and chemical study of the seed was made to aid in recognizing such admixtures. Under the microscope the sections and cellular structure show marked differences by which they may be readily dis-

tinguished. A chemical analysis shows the following differences between the two powders:

Chemical analysis of grains of Paradise and black pepper.

	Ash.	Alcoholic extracts.	Residuum after treating with 1 per cent H_2SO_4.
	Per cent.	*Per cent.*	*Per cent.*
Grains of Paradise	3.06	19.02	0.692
Black pepper	4.935	7.805	0.323

Various other methods are given for detecting the admixture, among which is the following: Five grams of the suspected pepper is macerated in a mixture of 10 grams of alcohol and 5 grams of ether and let stand for a day. If a drop of iron chloride be added to the filtrate no change in color will be noticed if the pepper be pure, but if adulterated with as much as 2 per cent of grains of Paradise a greenish brown color will be observed.—W. H. E.

The feeding value of leaves, F. Lehmann (*Ztschr. landw. Ver. Hessen, 1894, No. 6, pp. 42, 43*).—The author tested the feeding value of the leaves of the red beech gathered in August by feeding them to 2 sheep. The amount given was 300 grams of leaves per sheep daily, in addition to hay and grain. The coefficients of digestibility found for the leaves were, protein 6 per cent, fat 6 per cent, cellulose 26 per cent, and nitrogen-free extract 42 per cent. On this basis 100 pounds of air-dry beech leaves contained 0.6 pound of digestible protein, 0.7 pound of digestible fat, 5.7 pounds of digestible cellulose, and 20.5 pounds of digestible nitrogen-free extract, making in all 27.5 pounds of digestible organic matter. These values are lower than those given by Girard, who found that elm leaves were about equal to alfalfa hay. The low value of beech leaves is believed to be due to the leathery coating of the leaves, which hinders the digestion of the material.—E. W. A.

The feeding value of sawdust and wood meal, F. Lehmann (*Ztschr. landw. Ver. Hessen, 1894, No. 5, pp. 33, 34*).—The following analyses of sawdust and wood ground to an impalpable powder (wood meal) are given:

Composition of dry matter of sawdust and wood meal.

	Crude protein.	Crude fat.	Crude cellulose.	Crude ash.	Nitrogen-free extract.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Sawdust	0.69	0.69	72.29	2.14	24.19
Wood meal (powder)	0.54	0.33	54.56	13.13	31.44

The feeding value of these materials was tested by feeding them to 2 sheep in separate periods, the amount given being 300 grams per head daily, in addition to hay and grain. It was thought that by finely pul-

verizing the wood the constituents might be more thoroughly digested. This was, in fact, the case, for while practically none of the sawdust was digested, about 13 grams out of the ration of 300 of the wood meal was digested. Apparently the small amount of fat and the nitrogen-free extract were the only constituents digested. The author concludes that sawdust is of no value whatever for feeding purposes, and that while wood meal is slightly more digestible it is of no practical value for feeding.—E. W. A.

The effect of peanut cake, palm cake, and cotton-seed cake on milk, BACKHAUS (*Jour. Landw., 41, No. 4, pp. 328–332*).—The author studied this question on 10 cows. The 1 kg. of peanut cake in the basal ration was replaced with 1½ kg. of palm cake and with 1 kg. of cotton-seed cake, respectively, in four separate periods of about two weeks each. The daily ration per head was 30 kg. of ensiled beet residue, 5½ kg. of fresh brewers' grains, 1 kg. each of alfalfa hay, meadow hay, oat chaff, and wheat chaff, 5 kg. of oat straw, 1½ kg. of wheat bran, 1½ kg. of corn meal, and the above-mentioned oil cake.

The average composition of the milk in each period and the average yield per day of milk, total solids and fat, by the 10 cows were as follows:

Averages per day for ten cows.

Periods, and kind of oil cake.	Average daily yield of milk.	Average composition of milk.		Average daily yield of—	
		Total solids.	Fat.	Total solids.	Fat.
	Kg.	*Per cent.*	*Per cent.*	*Kg.*	*Kg.*
I.—1 kg. peanut cake	118.5	11.55	2.81	13.69	3.34
II.—1½ kg. palm cake	118.5	11.60	2.82	13.76	3.35
III.—1 kg. cotton-seed cake	109.0	11.68	2.94	12.73	3.21
IV.—1½ kg. palm cake	107.5	11.64	2.90	12.51	3.12

The results do not show any difference between the oil cakes in their effect on the milk. The amounts of oil cakes fed, although small, are said to correspond to those given in practice. The author's inference from the result is that the fat content of milk can be but little changed by the manner of feeding, and that the favorable action of certain concentrated foods which have been found to increase the fat is only apparent when these foods are fed in large quantities.—E. W. A.

Observations on the individual cows of a herd for one year, BACKHAUS (*Jour. Landw., 41, No. 4, pp. 305–320*).—The herd consisted of 51 Dutch cows imported direct from Holland or East Friesland. The observations extended from April 3, 1892, to April 1, 1893. During this time average samples of the milk of each cow were tested weekly, the weight of the milk yield was taken weekly, and the cows were weighed frequently. From the specific gravity and the fat found by the lactocrite the total solids and solids-not-fat were calculated. The data thus secured show that the average length of the milking

period was 329½, and the average production per cow during the year was 3,758.98 kg. of milk, 122.8 kg. of fat, and 451.07 kg. of total solids. The author shows the range of profitability among the cows. The relation of the fat to the solids not-fat is brought out, and that of the live weight, duration of milking period, and number of the milking period to the production of milk and fat.

For showing the relation of live weight to productibility the cows are grouped by weight into four lots and the annual yield per 1 kg. of live weight given as follows:

Annual yield per 1 kg. of live weight with different sized animals.

Live weight.	Milk.	Fat.
Kg.	*Kg.*	*Kg.*
474	100.0	100.0
522	85.0	74.4
563	59.8	69.7
625	65.6	69.4

The production of milk and fat was relatively higher in proportion to the weight in the case of the lighter animals.

The relation between the duration of the milking period and the yield of milk and fat was as follows:

Relation between length of milking period and productibility.

	Average length of lactation period.	Annual yield per 1 kg. live weight.	
		Milk.	Fat.
	Days.	*Kg.*	*Kg.*
Group 1	253	5.632	0.1786
Group 2	295	4.720	0.1742
Group 3	312	6.955	0.2284
Group 4	335	7.192	0.2365
Group 5	360	8.898	0.2811

The cows which gave milk the longest as a rule gave a considerable larger yield of milk and fat in proportion to their weight.

The herd included cows in the second, third, fourth, fifth, sixth, and seventh period of lactation. Grouping the cows according to the period of lactation in which they were, it was found that the cows in the third period of lactation gave the largest yields of milk and of fat.—E. W. A.

The effect of Glauber's salts on the udder and on the milk of cows, E. HESS, J. SCHAFFER, and M. LANG (*Landw. Jahrb. Schweiz, 7 (1893), pp. 210–229*).—In the introduction the authors state that in some parts of Switzerland it is a common practice among farmers to feed Glauber's salts to cows in place of common salt, as it is cheaper. Cases are mentioned of giving as high as 100 grams of Glauber's salts per cow daily.

To study the effect of Glauber's salts on the secretion of milk and on the milk itself, experiments were made with 4 Simmenthaler cows normal in every respect. The animals were closely observed by a veterinarian and subjected to frequent thorough examination. The experiments lasted from January 20 to April 10, 1893, and the observations on the animals extended to the following October 20. The food of the cows was a normal and common ration, and remained unchanged during the experiment. The following amounts of salts were added to the ration of each cow daily:

January 20–30	45 grams of common salt.
January 30–February 6	40 grams of Glauber's salts.
February 7–March 29	50 grams of Glauber's salts.
March 29–April 10	60 grams of Glauber's salts.
April 10–October	45 grams of common salt.

The clinical observations of the cows showed that 3 of them had a mild attack of intestinal catarrh, beginning about the twelfth day, which was soon checked. The milk in the case of all 4 of the cows ceased to form any froth during milking and had a peculiar salty taste, resembling a weak solution of Glauber's salts. All showed signs of pathological changes in the udder in the form of udder catarrh, mammitis, caking of the udder, or bloody milk.

The milk differed little or none in general appearance from the milk of healthy cows. It was analyzed daily during the experiment and for some time prior to and following the experiment. The most striking change was the behavior of the casein toward rennet. In six days after the feeding of Glauber's salts was commenced there was a noticeable decrease in the ability of the casein to curdle with rennet. During the time the cows were suffering with diseases of the udder the fat content of the milk was much higher than normally; and especially during udder catarrh the milk was richer in chlorides and poorer in phosphates.

The conclusion of the authors is that dairymen should be warned against feeding Glauber's salts regularly as a condiment.—E. W. A.

Oïdium lactis in milk, M. LANG and E. VON FREUDENREICH (*Landw. Jahrb. Schweiz, 7 (1893), pp. 229–237*).—The frequent occurrence of *Oïdium lactis* in milk is mentioned and its growth described. Experiments made by the authors indicate that this fungus has the ability to ferment glucose, milk sugar, cane sugar, and maltose, and to decompose the albuminoids of milk.—E. W. A.

Experiments in fattening sheep (*Norsk. Landmandsblad, 13 (1894), pp. 49–51*).—The experiments were conducted on seven farms in Stavanger Amt, Norway, financial aid for the purpose having been granted by the Government. The experiments were made to investigate the possibility of an export trade of sheep from Norway to England. In all 120 sheep of the Cheviot breed were used. The directions were that the sheep should weigh at least 100 pounds at the beginning of the

trials, and be fed uniformly according to the following schedule per 1,000 pounds live weight per day: 15 pounds of meadow hay, 100 pounds of turnips, 25 pounds of linseed cake, and 5 pounds of oats. This ration contains about 3.06 pounds of digestible protein, 15.25 pounds of carbohydrates, and 0.50 pound of fat, with a nutritive ratio of 1:5.4.

The live weight and gain of the sheep in the different lots are given in the following table:

Average results of sheep-feeding experiment.

Lot.	Number of animals.	Duration of experiment.	Live weight per head.		Average gain in live weight per head.
			Beginning.	End.	
		Days.	*Pounds.*	*Pounds.*	*Pounds.*
I	30	42	115.2	130.2	15.0
II	20	42	112.4	132.2	19.8
III	10	42	118.8	141.9	23.1
IV	30	69	107.8	127.6	19.8
V	10	73	112.2	132.0	19.8
VI	10	73	110.4	132.0	21.6
VII	10	73	112.2	133.8	21.6

The sheep were all shipped to England, the first three lots alive and the others dressed. Calculating the first cost of the sheep, cost of feed, and other expenses, the lots shipped alive yielded a small profit, while the lots shipped dressed were sold at a loss, owing to several unfortunate circumstances.—F. W. W.

Water content of Swedish butter (*Tidskr. Landtmän, 15* (*1894*), *pp. 73–75; Nordisk Mejeritidn., 9* (*1894*) *pp. 79, 80*).—The samples of butter exhibited at the Malmö and Gothenburg butter exhibitions in 1893 were examined for water content. The exhibit included 743 tubs of butter from 219 different creameries. The average water content was 13.86 per cent, the range being from 10.70 to 16.88 per cent.

The following table summarizes the results:

Water content of butter.

Per cent of water.	Number of samples.	Per cent of samples.
10.70–10.99	4	0.5
11.00–11.99	39	5.3
12.00–12.99	110	14.8
13.00–13.99	250	33.6
14.00–14.99	222	29.9
15.00–15.99	98	13.2
16.00–16.88	20	2.7
	743	100.0

The highest average water content for the butter from any one creamery was 16.42 per cent, and the lowest 11.43 per cent. The average water content of the butter by creameries in shown below:

Water content of butter by creameries.

Per cent of water.	Number of creameries.	Per cent of creameries.
11.43–11.99	8	3.6
12.00–12.99	30	13.7
13.00–13.99	80	36.5
14.00–14.99	79	36.1
15.00–15.99	21	9.6
16.42	1	0.5
	219	100.0

The average water content of Danish creamery butter, as found by the Royal Danish experiment station at Copenhagen (E. S. R., vol. IV, p. 690), was 14.59 per cent, or 1.73 per cent higher than the above average for Swedish butter.—F. W. W.

Experiments in preventing the swelling of cheese, E. VON FREUDENREICH (*Landw. Jahrb. Schweiz, 7 (1893), pp. 81–87*).—The author explains that the production of large amounts of gas in cheese during ripening, causing the cheese to swell and in some instances to crack open, is most feared of any of the evils which attend the ripening of cheese. There is little ground for doubt, he says, that this gas production is due to the action of certain bacteria. He mentions *Bacillus guillebeau*, *a*, *b*, and *c*, and *Bacillus schafferi*, described by himself, as capable of causing this trouble. He found by comparative experiments that salt was beneficial in preventing this trouble. Cheese to which 3 per cent of salt was added during making was nearly free from swelling, while cheese made from the same milk without salt was full of cavities. His method is to dip off about two thirds of the whey after heating the curd and add 3 per cent of salt to the remainder. The rest of the operation is as usual.

He does not claim that salt is an absolute preventative against this evil but merely offers the results of his experiments as a suggestion for more extensive trials in practice.—E. W. A.

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Concerning casein and the organic phosphorus of casein (*Sur la caséine et le phosphore organique de la caséine*), A. BÉCHAMP.—*Bul. Soc. Chim. Paris, 11–12 (1894), No. 4, pp. 152–176.*

Concerning the chemistry of living protoplasm (*Ueber den Chemismus im lebenden Protoplasma*), G. WENDT.—*Ztschr. Naturw. Jena, 21 (1893), No. 1, pp. 53–75; abs. in Bot. Centbl., 57 (1894), No. 2, pp. 46, 47.*

The carbohydrates of yeast (*Ueber die Kohlenhydrate der Hefe*), E. SALKOWSKI.—*Ber. deut. chem. Ges., 27 (1894), No. 4, pp. 497–502.*

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Methods of distinguishing the coloring materials in butter (*Manière de reconnaître les matieres colorantes dans le beurre*).—*Jour. Agr., 5 (1894), No. 48, p. 50.*

Method for distinguishing between butter and oleomargarin (*Différence entre le vrai beurre et le beurre margariné*).—*Jour. Agr., 5 (1894), No. 48, p. 50.*

Contributions to the analysis of adulterated butter (*Contributions à l'analyse des beurres margarinés*).—*Rev. Agron., 1893, No. 3, pp. 152–157.*

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A new oven for calorimetry in ice (*Nouvelle étuve pour calorimètre à glace*), W. LOUGUININE.—*Ann. Chim. et Phys., 1 (1894), sér. 7, pp. 423–432, figs. 6.*

New forms of apparatus for organic analysis, J. LIECESTER.—*Chem. News, 69 (1894), No. 1790, p. 130, figs. 4.*

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Concerning the influence of light upon the growth of transplanted plants (*Ueber den Einfluss des Lichtes auf die Fortpflanzung der Gewächse*), G. KLEBS.—*Biol. Centbl., 1893; abs. in Bot. Centbl., 57 (1894), No. 5, pp. 136–138.*

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Can the farmer determine which artificial fertilizers to apply to his land? (*Kan landmanden udfinde hvilke kunstige gjödningsmidler lönner sig at anvende paa hans jord?*), N. WILLE.—*Tidsskr. f. det norske Landbr., 1 (1894), pp. 30–39.*

Fertilizing materials in night soil (*Der Gehalt der Fäcalien an Pflanzennährstoffen*), A. VON PODEWILS.—*Chem. Ztg., 18 (1894), No. 18, pp. 312, 313.*

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Concerning the presence of dodder in clover seed (*Die Bekämpfung der Kleeseide*), LACHNER.—*Fühling's landw. Ztg., 43 (1894), No. 4, pp. 122–125.*

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DISEASES OF PLANTS.

Diseases of carnations.—*Garden, 45 (1893), No. 1165, p. 223.*

Brunnisure of the grape in Italy (*La Brunnisure de la vigne en Italie*), F. CAVARA.—*Rev. Internat. Vit. et Oenol., 1 (1894), No. 1, pp. 3–9.*

A canker disease of the oak caused by Agloaspora taleola (*Eine krebsartige Rindenkrankheit der Eiche erzeugt durch Agloaspora taleola*), R. HARTIG.—*Forst. naturwiss. Ztschr., 1893, No. 1, pp. 1–6; abs. in Bot. Centbl., 57 (1894), No. 6, pp. 180, 181.*

Concerning the destruction of Thuja menziesii and Pseudotsuga douglasii by Pestalozzia funerea (*Ueber das Absterben (Pestalozzia funerae) von Thuja menziessi und Pseudotsuga douglassii*), B. BOHM.—*Ztschr. Forst. und Jagdw., 26 (1894), No. 2, pp. 63–71.*

The symbiosis of Heterodera radicicola with plants cultivated in the Sahara (*Symbiose de l'Heterodera radicicola avec les plantes cultivées au Sahara*), P. VUILLEMIN and E. LEGRAIN.—*Compt. Rend., 118 (1894), No. 10, pp. 549–551.*

Note on Puccinia peckiana (*Note sur le Puccinia peckiana*), A. JACZEWSKI.—*Bul. Herb. Boissier, 2 (1894), No. 2, pp. 142–144.*

Concerning Pythisma spp. and allied fungi (*Zur Kenntniss des Runzelschorfes und der ihm ähnlichen Pilze*), J. MÜLLER.—*Pringsheim's Jahrb. wiss. Bot., 25 (1893), No. 4, pp. 21; abs. in Bot. Centbl., 57 (1894), No. 11, pp. 346–348.*

The parasitic Exoasci (*Die parasitischen Exoasceen*), R. SADEBECK.—*Arbeiten Bot. Mus. Hamburg, 1893, pp. 110, figs. 3; abs. in Bot. Centbl., 57 (1894), No. 11, pp. 334–338.*

Concerning the stimulus which is produced by treating potato plants with copper (*Ueber den Reiz, welchen die Behandlung mit Kupfer auf Kartoffelpflanze hervorbringt*), B. FRANK and F. KRÜGER.—*Ber. deut. bot. Ges., 12 (1894), No. 1, pp. 8–11.*

Coupling for spraying hose (*Raccord Huet pour tuyaux d'arrosage*), G. D. HUET.—*Rev. Hort., 66 (1894), No. 6, pp. 135–137.*

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On the habits of a Jamaica spider, T. D. A. COCKERELL.—*Nature, 49 (1894), p. 412.*

The Hessian fly (*Cecidomyia destructor*), W. M. SCHÖIEN.—*Tidsskr. f. det norske Landbr., 1 (1894), pp. 8–15.*

Oöspora destructor, the green mildew of insects (*Oöspora destructor, champignon produisant sur les insectes la muscardine verte*), G. DELACROIX.—*Bul. Soc. Mycol., 1893, p. 260; abs. in Bot. Centbl., 57 (1894), No. 8, pp. 239, 240.*

Concerning the larvæ of Cochylis ambiguella and new methods of combating the same (*Sulle larve della Cochylis ambiguella e sulla efficacia dei nuovi mezzi proposti per distruggerle*), G. DEL GUERCIO.—*Staz. Sper. Agr. Ital., 25 (1893), No. 3 and 4, pp. 280–305.*

The crow as an insectivorous bird (*Destruction du ver gris de la betterave; utilité des corneilles*), E. LEPLAE.—*Rev. Agron., 1893, No. 3, pp. 167–174.*

FOODS—ANIMAL PRODUCTION.

Cooked and uncooked milk for infants (*Rohe und gekochte Milch in der Säuglingsernährung*), DROUET.—*Rev. Internat. Falsif., 6; abs. in Ztschr. Fleisch- und Milchhyg., 4 (1894), No. 5, p. 95.*

Storage experiments with frozen meat (*Lagerungsversuche mit gefrorenem Rind-, Schweine- und Hammelfleisch*), GLASSMANN.—*Ztschr. Fleisch- und Milchhyg., 4 (1894), No. 4, p. 72.*

Notes: Adulterated bran; volume and weight of flour; does tannin tan the animal hide? (*Kleine Mittheilungen*), T. F. HANAUSEK.—*Chem. Ztg., 18 (1894), No. 17, pp. 287, 288.*

Feeding experiments with rape cake for milch cows (*Fütterungs-Versuch mit Rapskuchen*), VON LIEBENBERG.—*Mitt. Ver. Förd. landw. Versuchsw. in Oesterr., 1893, No. 8, part 2, pp. 155–162.*

Rations for dairy cows (*Die rationelle Fütterung des Milchviehes*), A. ARNSTADT.—*Milch Ztg., 23 (1894), No. 7, pp. 104, 105.*

The feeding value of twigs (*Der Futterwerth des Reisigs*), F. LEHMANN.—*Ztschr. landw. Ver. Hessen (1894), No. 7, pp. 50–52.*

The wood litter question (*Die Waldstreufrage*), E. EBERMAYER.—*Forst. naturwiss. Ztschr., 3 (1894), pp. 110-112.*

Report of the Hohenheim Experiment Station on the feeding stuffs control in 1893 (*Bericht der landwirtschaftlichen Versuchsststion Hohenheim über die Kontroll des Futterhandels im Jahre 1893*), KREUZHAGE.—*Württ. Wochenbl. Landw., 1894, No. 9, pp. 110–113; No. 10, pp. 125–127.*

VETERINARY SCIENCE AND PRACTICE.

Experiments in feeding the spores of stinking smut of wheat to domestic animals (*Versuche mit der Fütterung mit Steinbrandsporen*), PUSCH.—*Abs. in Fühling's landw. Ztg., 43 (1894), No. 4, p. 127.*

Concerning the infectiousness of the blood of tuberculous cattle (*Ueber die Infektiosität des Blutes tuberkulöser Rinder*), BOLLINGER.—*Münch. med. Wochenschr., 1893, No. 50; abs. in Ztschr. Fleisch- und Milchhyg., 4 (1894), No. 4, pp. 69, 70.*

Contagious diseases in cattle and swine (*Smittosamma sjukdomar hos nötkreatur och svin*), J. WETTERWIK.—*Nord. Mejerie Tidn., 9 (1894), pp. 39, 40, 51, 52.*

A study of Trichina (*Zur Lehre von der Trichinosis*), M. ASKANAZY.—*Centbl. Bak. und Par., 15 (1894), No. 7, pp. 225–227.*

Bacteriological examinations of blood in sepsis, pyæmia, and osteomyelitis (*Bakteriologische Blutuntersuchungen bei Sepsis, Pyämie und Osteomyelitis*).—*Deut. med. Ztg., 1893, No. 97; abs. in Ztschr. Fleisch- und Milchhyg., 4 (1894), No. 4, pp. 70, 71.*

DAIRYING.

Report of general meeting of the German Dairy Association (*Deutscher Milchwirtschaftlicher Verein*).—*Milch Ztg., 23 (1894), No. 8 pp. 115–117; No. 9, pp. 131–134; and Molk. Ztg., 8 (1894), No. 8, pp. 109, 110; No. 9, pp. 125–127.*

The milk supply of Leipsic and its effect on the health of children (*Einfluss der Beschaffenheit von Milch und Wohnung auf das Gedeihen der Ziehkinder in Leipzig*), PLAUT.—*Ztschr. Hyg., 15, No. 2; abs. in Ztschr. Fleisch- und Milchhyg., 4 (1894), No. 4, pp. 73, 74.*

Concerning the milk supply of Naples (*Die Milch in Neapel*), MONTEFUSCO.—*Abs. in Ztschr. Fleisch- und Milchhyg., 4 (1894), No. 4, pp. 74, 75.*

On the water content of butter (*Ueber den Wassergehalt der Butter*), DU ROI.—*Molk. Ztg., 8 (1894), No. 9, pp. 127, 128.*

The fat content of milk, its agricultural importance, and its increase (*Der Fettgehalt der Milch, seine wirtschaftliche Bedeutung and Vergrösserung*).—*A review. Milch Ztg., 23 (1894), No. 8, pp. 117–119.*

Bacteriology in the dairy (*Die Bakteriologie in der Milchwirtschaft*), E. VON FREUDENREICH, *1893, pp. 78; Basel: C. Sallmann; abs. in Bot. Centbl., 57 (1894), No. 5, pp. 156, 157.*

Sterilization of milk (*Ueber das Sterilisiren der Milch*), A. STUTZER.—*Ztschr. angew. Chem., 1894, No. 4, pp. 130, 131.*

The effect of high temperatures on tuberculosis bacilli in milk (*Ueber die Einwirkung hoher Temperaturen auf Tuberkelbazillen*), J. FÖRSTER.—*Milch Ztg., 23 (1894), No. 6, pp. 84, 85.*

A slimy fermentation of milk (*Ueber eine schleimige Gährung der Milch*), G. LEICHMANN.—*Landw. Vers. Stat., 43, No. 5, pp. 375–398.*

A new stopper for milk vessels (*Ein neuer Verschluss für Milchflaschen*).—*Ztschr. Nahr. Untersuch., 1893, No. 21; abs. in Ztschr. Fleisch- und Milchhyg., 4 (1894), No. 4, pp. 72, 73.*

Antiseptics as milk preservatives (*Ueber Konservierung der Milch durch Antiseptica*), JULES and STOKES.—*Rev. Internat. Falsif., 6; abs. in Ztschr. Fleisch- und Milchhyg., 4 (1894), No. 5, p. 96.*

The concentration of the substance in milk used as a preventive of tetanus (*Beiträge zur Konzentrierung der gegen Wundstarrkrampf schutzenden Substanz aus der Milch*), L. BRIEGER and G. COHN.—*Ztschr. Hyg., 15 (1893), p. 439; abs. in Chem. Ztg., 18 (1894), No. 8, Repert., p. 21; Milch Ztg., 23 (1894), No. 6, p. 85.*

On pasteurization of cream (*Om gräddans pasteurisering*), H. P. LUNDE.—*Nord. Mejerie Tidn., 9 (1894), pp. 41, 42, 68.*

On the churning process and the formation of butter (*Ueber den Butterungsprozess und Butterausscheidung*), A. TSCHERKASSOW.—*Milch Ztg., 23 (1894), No. 7, p. 103.*

The butyrometer (*Några ord om butyrometern*), C. HULTMAN.—*Nord. Mejerie Tidn., 9 (1894), pp. 51, 78.*

Test of cream separators (*Les écrémeuses centrifuges au concours de Bouchout*), THEUNIS.—*Rev. Agron., 1893, No. 3, pp. 175–197.*

Concerning the green coloration of cheese (*Sulla colorazione verde del formaggio di grana Lombardo*), C. BESANA.—*Staz. Sper. Agr. Ital., 25 (1893), No. 3 and 4, pp. 275–279.*

The ripening of cheese from a bacteriological point of view (*La maturazione dei formaggi del punto di vista batteriologico*), N. BOCHICCHIO.—*L'Agricol. et Ind. Agr., 17 (1894), No. 2, pp. 24–27; No. 3, pp. 41–44.*

On the present conditions of the manufacture of cheese in Sweden (*Ostproduktionens ståndpunkt i vårt land samt medlen för densammas Nöjande*), G. LILJHAGEN.—*Nord. Mejerie Tidn., 9 (1894), pp. 78, 79.*

On the manufacture of cheese in Switzerland and Holland (*Om osttillverkningen i Schweiz och Holland*), A. FRIIS.—*Nord. Mejerie Tidn., 9 (1894), pp. 42, 43, 80, 81.*

The Swedish cheese exhibition in Stockholm, 1894 (*Allm. Svenska ostutställningen i Stockholm*).—*Nord. Mejerie Tidn., 9 (1894), pp. 65, 66, 77, 78; Tidskr. Landtmän, 15 (1894), pp. 97–99, 111, 112.*

The employment of the eudiometric method in the examination of water and rennet used in the manufacture of cheese (*L'emploi de la méthode eudiométrique pour l'examen du lait de la présure et de l'eau dans la fabrication du fromage*), SCHAFFER.—*Ind. Lait., 18 (1893), No. 31 and 32, pp. 403–405, 412, 413.*

Determination of the acidity of milk by Dornic's acidimeter (*Examen du lait; l'acidimètre Dornic*), P. PACCAUD.—*Ind. Lait., 18 (1893), No. 49, pp. 387, 388.*

On the question of the determination of the specific gravity of curdled milk (*Zur Frage über die spez. Gewichtbestimmung geronnener Milch*), J. OKULITSCH.—*Milch Ztg., 23 (1894), No. 6, p. 84.*

TECHNOLOGY.

Selected yeasts in wine-making (*Sur levûres sélectionnées dans la fabrication du vin*), F. BERTHAULT.—*Ann. Agron., 20 (1894), No. 2, pp. 65–78.*

Study of the modifications produced in wines by cultivated ferments (*Étude des modifications apportées dans les vins par les levûres cultivées*), J. PERRAUD.—*Rev. Internat. Vit. et Oenol., 1 (1894), No. 1, pp. 10–17.*

Wine and sulphuring (*Les vins et soufrage*), L. ROOS.—*Rev. Internat. Vit. et Oenol., 1 (1894), No. 1, pp. 17–23.*

On the manufacture of fermented liquors from sugar beets (*Brändvin af roer*), C. H. D. ZAHRTMANN.—*Landmandsblade, 27 (1894), pp. 89–96.*

Chemical composition of the wines of Apulia (*Intorno alla composizione chimica dei vini da taglio di Puglio*), A. FONSECA.—*Staz. Sper. Agr. Ital., 25 (1894), No. 3 and 4, pp. 306–320.*

The sugar-beet industry in the United States (*Die Rübenzucker-Industrie der Vereinigten Staaten von Nord-Amerika*), A. HERZFELD.—*Ztschr. Ver. Rübenz. Ind., Jan., 1894, pp. 55–134.*

MISCELLANEOUS.

Report of the sixth general meeting of the Association of German Experiment Stations, Sept., 1893 (*Verhandlung der VI. Hauptversammlung des Verbandes landwirtschaftlicher Versuchs-Stationen im Deutschen Reich zu Würzburg am 8. und 9. September, 1893*).—*Landw. Vers. Stat., 43, No. 5, pp. 321–374.*

Lower agricultural instruction in Denmark (*Några ord om den lägre landtbruksundervisningen i Danmark*), V. JONSSON.—*Tidskr. Landtmän, 15 (1895), pp. 99–105.*

Agriculture and dairying in New Zealand (*Landtbruks- och Mejeriförhållandena paa Nya Zeeland*), H. OLSEN.—*Nord. Mejerie Tidn., 9 (1894), pp. 29, 30, 40, 41, 53, 54, 69.*

EXPERIMENT STATION NOTES.

Georgia Station.—This station has adopted the plan of supplying the weekly papers of the State with results of work at the station, answers to questions, and other matter for the information of farmers, in the form of plates. These stereotype plates—sufficient to make up about three columns—are sent monthly by express to each of the papers selected, and are intended to appear in all of these papers during the same week. This plan promises to prove a most valuable and inexpensive means of communicating station results and station advice to the farmers.

Indiana Station.—W. Brady, who has been temporarily acting as assistant chemist to the station, March 1 resumed his duties as first assistant chemist at the Chicago Steel Works.

Kansas Station.—The station is about to undertake experiments in irrigation upon small areas by means of water pumped into reservoirs from wells. Two locations have been selected, one near Garden City, Finney County, and the other in Decatur County. The work in this line for the present year will be chiefly confined to water supply for common garden crops.

M. A. Carleton, assistant in botany for the past two years, has accepted a position in the Division of Vegetable Pathology of this Department. His place will be taken for the present by J. B. S. Norton.

Massachusetts Stations.—The bill providing for the union of the State and Hatch stations has passed the State legislature. This bill unites the two stations to form the experiment department of the college. The whole interest of the bill is to promote economy in the work and administration. A special committee on reorganization will be appointed at an early date.

Michigan Station.—H. S. Dunning has been placed in charge of the newly established poultry department. A. A. Crozier has been appointed assistant agriculturist in charge of field experiments. A dairy school was conducted by the agricultural college the past winter. Abstracts of the station bulletins are sent to the newspapers of the State as press bulletins. Some results of spraying, with directions for spraying, have been distributed in the form of small charts suitable for hanging in grange halls, post offices, and other public places.

Mississippi Station.—W. L. McGee, assistant director of the station, has been elected professor of agriculture in the Clemson College, and entered upon his new duties March 1.

Ohio Station.—J. E. Barclay, recently a student at the University of Wisconsin, has been appointed superintendent of the Northwestern Substation, vice J. S. Hine, resigned.

Vermont College.—The third annual session of the Vermont Dairy School was held for five weeks in January and February. The entire time was devoted to the study of butter dairying. There were twelve separators, three churns, three butter workers, and three styles of milk testers in use. Two courses of lectures, aggregating nearly fifty lectures on dairy topics, were delivered. All lectures and working records were mimeographed and bound for students' use. Nearly eighty applications for entrance were received, of which thirty, mainly from outside the

State, had to be refused, owing to lack of accommodations. The next session of the school will be held in January, 1895, and a considerable number of persons have already applied for entrance.

Report of the Agricultural Station at Laon, France, for 1893 (pp. 364).—This station is located in the Department of Aisne, and its officers consist of a director and chemist, L. Gaillot, and an assistant, P. Serent. Its objects are stated to be (1) investigations relating to methods of increasing the productiveness of the soil, both in the laboratory and in the field; (2) analyses of soils, fertilizers, waters, and products of agriculture and kindred industries; (3) seed testing, and (4) meteorological observations applied to agriculture. During the year 2,248 analyses, requiring 6,671 separate determinations, were made. Of these, 712, representing a cost of 13,262 francs ($2,519.78), were made gratuitously in connection with the fertilizer inspection, etc., of the department; the remaining 1,536 were paid for, furnishing a revenue of 8,702 francs ($1,653.38).

A few cases of fraud in fertilizers were exposed during the year. Purchase of fertilizers through the agricultural syndicates, which are organized in all of the departments of France, is strongly recommended. Better terms are thus secured than small individual buyers are able to make. The quality of the materials is also assured. Small farmers were also victimized to a large extent during the year by dealers in condimental foods for stock. In the majority of cases there was no redress, since there is no special law in France regulating the sale of such materials.

An important feature of the work of the year was the instruction given each Thursday to the pupils of the Laon lyceum, in the analysis of fertilizers and soils and in microscopy, together with excursion to the principal farms of the region and to the experimental fields of the station.

The leading articles of the report, the more important of which are abstracted elsewhere in the Record, are: (1) A summary of meteorological observations for each month of the year; (2) A study of the arable soils of the department (p. 902); (3) Field experiments on the experimental farm at Montreuil, including experiments with fertilizers on sugar beets, wheat, potatoes, oats, with different forms of nitrogen, phosphoric acid, and potash on potatoes, and tests of pyrites cinder and sulphate of iron on potatoes and oats; (4) Investigations on the destruction of white grubs; (5) Note on the degree of exactness possible in fertilizer analysis; (6) Observations on the culture of hairy vetch; (7) A geological sketch of the department; (8) Geographical distribution of the different soils of the department (p. 903); (9) Composition of sugar beets at different stages of growth; (10) Researches on the beet nematode (*Heterodera schachtii*) (p. 912); (11) Note on a nematode disease of rye (p. 913); (12) Analyses of feeding stuffs; and (13) A tariff of fees for analyses.

The latter shows that for a complete chemical analysis of a soil 20 francs ($3.80) is charged, and for a physical chemical analysis—sand, clay, lime, and humus—5 francs (95 cents). In case of fertilizers, determination of nitrogen separately in the three forms costs 10 francs ($1.90), phosphoric acid in three forms 9 francs ($1.71), and potash 4 francs (76 cents). Other fees are as follows: Hardness of water, 2 francs; chlorine, sulphuric acid, and organic matter in addition to hardness, 6 francs; specific gravity, fat, sugar, nitrogenous matter, and ash of milk, 10 francs; water, fat, ash, and examination for foreign fats in butter, 10 francs; identity and purity of seeds, each 1 franc; vitality, 5 francs; examination for dodder, 2 francs.

Report of Agricultural College at Aas, Norway.—The report of the Agricultural College at Aas, Norway, for 1891–'92, recently published (*Beretning om den höjere Landbrugsskole i Aas, Cristiania, 1894, pp. 185*), shows that the total expenditures of the college during the fiscal year were $43,845. Of this sum, $6,770 was paid out for salaries and labor, and $10,138 for running expenses. The annual Government appropriation for the college amounted to $13,913, with a special appropriation during 1891–'92 of $18,224 for improvements in buildings and equipment.

The receipts from the sale of farm products—milk, cream, butter, cereals, potatoes, nursery stock, etc.—amounted to $12,540, and the total expenses connected with the farm were $8,793, leaving a balance of $3,744 in its favor.

EXPERIMENT STATION FOR TRIALS OF AGRICULTURAL MACHINERY AND TOOLS.—In the last number of the *Transactions of the Royal Swedish Agricultural Society* is printed a petition to the King for the establishment of an experiment station for testing and examining agricultural machinery and tools. The committee appointed by the society to investigate the matter recommends that such a station be established for the purpose of furnishing the farmer with complete and reliable information concerning agricultural machinery and of advancing home production of such machinery. The machines are to be judged on the following points: Capacity as regards time and power used, quality of the work done, cost of the work done, technical perfection, and wear. The plan of station organization provides for a director, an assistant, and a secretary as permanent officers, and expert judges for special trials of machinery. The expenses of the station are to be covered by an annual appropriation of about $1,200 and by fees paid for trials of machinery for private individuals.

THE GRANDEAU METHOD FOR HUMUS IN SOILS.—H. Snyder contributes to the *Journal of the American Chemical Society* (*16* (*1894*), *No. 3, March, pp. 210–213*) some notes on the Grandeau method for the determination of humus in soils. He finds the original Grandeau method open to serious objections. He describes the following simple modifications, which have given good results in his work:

"After treatment with the dilute acid, the soil is transferred to either a glass-stoppered bottle or a glass-stoppered Erlenmeyer flask of 100 c. c. capacity, using 50 or 60 c. c. of the dilute ammonia solution for that purpose. The contents of the bottle or flask are then well shaken at frequent intervals, and then allowed to settle. After settling, the dark-colored solution is decanted into a filter, a fresh 50 c. c. portion of the dilute ammonia solution is then added to the flask, and the same treatment repeated. It usually requires three or four such treatments before the filtrate becomes clear; the contents of the flask are then brought on to the filter, and require but little farther washing in the usual way before this part of the operation is completed. While the second, third, and fourth treatment with the ammonia is being carried on, the first portion of the filtrate can be evaporated on the water bath, and thus save time when that part of the operation is reached. The most progress can be made by making as large a number of determinations at one time as a person can conveniently take care of, so as not to unnecessarily hurry the operations, nor loose too much time in making the humus determinations of the soil. A separate room for such work is a great convenience.

"The results obtained by this method of treatment are much higher than those obtained when working in the usual way. This is to be expected, inasmuch as more complete extraction of the humus materials are obtained by using the glass-stoppered flasks. Duplicate results with the ordinary Grandeau method are far from being concordant, while with the glass-stoppered flasks reasonably concordant results are secured."

RECENT PROGRESS IN THE ANALYSIS OF CATTLE FOODS.—In a paper on this subject in the *Journal of the American Chemical Society* (*16* (*1894*), *No. 3, pp. 174-178*), F. W. Woll compares the methods at present in use for the analysis of cattle foods with the Weende methods proposed by Henneberg in 1864. He finds that the present methods are essentially the Weende methods. He concludes that "more progress has been made in our knowledge of the composition of food stuffs and in the identification of these constituents than in their estimation. While brought to a certain perfection as far as working details go, the analytical side is yet far behind, and no fully satisfactory system of fodder analysis can be worked out until we are able to classify nutrients more according to their physiological importance than is done in our present methods."

Testing soils by the colors of the plant foliage.—In *American Agriculturist, 1894, February* (*p. 61*), W. A. Macdonald gives an illustrated account of the method of judging of the fertilizer requirements of a soil by means of the color of the plant foliage, as worked out by Ville in a series of experiments with fertilizers on various plants.

The deepest shade of green observed in the plant is designated as 100, and the lighter shades are graduated downward. At the beginning of the investigations the colors as observed in the leaves, either in mass or separately, were compared with a series of standard colors, but it was afterwards found more accurate to use for the comparison the solutions obtained by extracting the coloring matter from a given weight of leaves, first with petroleum ether and then with absolute alcohol.

In this improved process the chlorophyll and the xanthophyll were separated and the intensity of color of each determined.

In the experiments described it is shown that in general "the higher and heavier the plant the deeper was the color of the foliage, while the lower and lighter the plant the paler was the color," and further, "that a deep green foliage indicated an ample supply of nitrogen in the soil. A light green may indicate a soil lacking in nitrogen or in potash. * * * Intermediate shades, between deep and pale green, generally indicate a want in all the elements of fertility, while a somewhat darker green points to a lack of phosphoric acid."

Phosphates of Algeria.—Under the title of *Un Voyage en Algérie* (*pp. 15*), D. Crispo, director of the State Agricultural Laboratory of Amsterdam, publishes an account (extracted from *Jour. Anc. élèv., Gembloux*) of a tour of inspection of the agriculture, mines, and phosphates of Algeria. The comparatively recently discovered phosphates of this country receive especial attention.

As far as present explorations show, there are three principal deposits of these phosphates: (1) Those in the vicinity of Nemours found in the form of nodules in beds of glauconite or filling fissures in limestone, which are just beginning to be exploited. They contain from 11.06 to 38.17 per cent of phosphoric acid and from 0.81 to 2.35 per cent of iron and alumina. (2) The gypseous phosphates of Gafsa, the extent of which has been estimated at 6,000,000 tons (which is probably too low an estimate), and which contain from 22.63 to 30.67 per cent of phosphoric acid and 1.11 to 1.37 per cent of iron and alumina, according to the amount of gypsum present. (3) The deposits found in caves on the borders of the plain of Chéliff, the most remarkable being those in the vicinity of Inkerman. These phosphates have been derived from accumulations of bat manure and consist of four distinct forms: (*a*) Fresh guano, containing 4.4 per cent of nitrogen and 6.92 per cent of phosphoric acid; (*b*) old guano, containing 0.16 per cent of nitrogen and 10.26 per cent of phosphoric acid; (*c*) brown ferruginous phosphate, containing 29.2 per cent of phosphoric acid and 15.62 per cent of iron and alumina; and (*d*) red ferruginous phosphate, containing 13.36 per cent of phosphoric acid (1.96 per cent soluble in citrate) and 15.38 per cent of iron and alumina. The theory of the formation of the different deposits is discussed.

Field experiments with fertilizers in Anglesey, Wales.—In a sixteen-page bulletin published by the University College of North Wales, Bangor, D. A. Gilchrist, C. B. Jones, and T. Winter report the results of experiments during 1893 with barnyard manure and various commercial fertilizers on ruta-bagas at five farms in different parts of Anglesey, on mangel-wurzels at two farms, on potatoes at one farm, and on pasture lands at two farms; and of experiments to test the best quantity of seed to sow for oats. Notes on the function, composition, and valuation of manures, and on manure mixtures for different crops are also given.

Maize: a botanical and economic study.—Under this title J. W. Harshberger gives in *Contributions from the Botanical Laboratory of the University of Pennsylvania* (*1, No. 2, pp. 75–202*) an elaborate botanical monograph on the corn plant, arranged under the following headings: Botany, origin, geographical distribution,

chemistry, agricultural and physiological study, utility, economic considerations, and predictions for the future of maize.

Maize is considered by the author to have originated in Mexico at an elevation of about 4,500 feet in a limited area just north of the Isthmus of Tehuantepec and south of 22° north latitude, probably among the Maya tribes. The date is placed at about the beginning of the present era. In supporting this claim he offers his proofs under the head of meteorological, botanical, archæological, ethnological, philological, and historical proofs, and they are cleverly arrayed to substantiate his claims and refute the claim sometimes made that it is of Old World origin.

From its early home corn spread north and south among the aborigines, reaching the Rio Grande River, according to Humboldt, about 700 A. D., and it reached the coast of Maine about 1000 A. D., having covered the intervening territory. It was carried to Europe through Spain shortly after the discovery of America, its rapid extension being due to its importance as an article of food.

Chemical analyses are given of various parts of the plant to show its value as an article of food, what elements are taken from the soil, that the deficiency may be supplied, and the value of the by-products and waste, that these may be utilized.

Questions of agricultural practice are considered beyond the limits of the bulletin, but the physiology of the plant is thoroughly discussed and it is shown how it is that corn, by making its growth at the season it does, does not exhaust the available nitrogen of the soil as quickly as wheat, which has its growing period earlier in the year. "The nitrogen is best conserved with a crop whose period of growth extends into the period of maximum nitrification and maximum drainage of nitrates from the soil. Maize is such a crop, and cereal crops whose growing periods are confined to the spring and early summer seasons are very poor conservers of nitrogen."

Under the head of utility the author considers corn as a source of human food, of animal food, of medicine, in the production of alcohol, sugar, paper, oil, fuel, potash, etc. The value of maize as a human food is dwelt upon and comparative values given in tabular form.

A chapter on the relation of this crop to the agricultural prosperity of the country is given, together with some suggestions as to rotation of crops and the special adaptation of different parts of the United States to this and other crops.

In conclusion the author believes "that maize, our greatest arable crop, is to hold in America the place that rice fills in India, China, and Japan, that cassava fills in South America, that sago occupies in Borneo, Java, and the Indian Archipelago—the staple food for man."

A chapter is devoted to the gross anatomy, histology, and synonymy of the plant, and under every chapter of the bulletin is given an elaborate bibliography.

Culture of peanuts in lower Egypt.—In an article on this subject (*Bul. Sta. Agron. Loire-Inférieure, 1891–'92, pp. 119–155*), Andouard and Letourneau give notes on the history and botany of the peanut, cultural methods adopted in Egypt, meteorological data for Lower Egypt, and analyses of Egyptian soils and of the peanut plant at various stages of growth. An abstract of the results relating to the composition of the plant at different periods of growth has already been given (E. S. R., vol. v, p. 422).

The crop of peanuts grown in Senegal in the season of 1892–'93 is given as 60,000 tons. The usual yield under irrigation in Lower Egypt is 1,750 to 3,500 pounds per acre, a yield far beyond that obtained in Europe.

It is stated that a crop of 3,500 pounds of unshelled nuts yields about 2,375 pounds of decorticated nuts, which afford 950 pounds of oil. This oil the author values at about 8½ cents per pound, or about $81 an acre.

The fertilizing constituents in the cake are given in percentages as follows: In the undecorticated cake, nitrogen 5.50, phosphoric acid 0.96, and potash 0.72; in the decorticated, nitrogen 7.60, phosphoric acid 1.75, and potash 1.40.

Collection of seeds of wild leguminous plants.—The Swedish Seed Association offers $1.10 to $1.35 per kilogram for seed of *Vicia cracca* and *Lathyrus pratensis*,

"considerably more" for *Vicia sepium* and *V. sylvatica*, and from $3.25 to $4.05 per kilogram for the larger species of *Lathyrus*.

INSECTS AS THE CAUSE OF POTATO SCAB.—A. D. Hopkins, entomologist of the West Virginia Station, has announced that as the result of investigations which he has recently completed he is convinced that certain forms of potato scab and rot are primarily caused by the attacks of one or more species of fungus gnats. Breeding experiments showed that the larvæ of these insects not only cause the scab in healthy tubers which have been wounded or scratched but that they also "eat minute holes in the sound skin of young growing potato tubers, thus causing the first form of the surface scab. They cause an erosion or irritation of irregular spots and patches on the surface of young tubers, which would naturally result in the second and third stages of the surface forms of the scab. They also attack the healthy skin and make cavities resembling the first forms of the deep scab. They may either singly or in combined forces cause, within a few hours, any of the injuries we have mentioned, and then abandon the tubers to enter the earth or to attack tubers in other places. Thus frequent searches for the larvæ during the growing season may fail to detect them feeding on the healthy portion of the tuber. It was also found that after an attack was once made, provided the conditions remained favorable, generation after generation may develop in the tuber and extend the original injuries until all of the inner substance of the tuber is converted into a mass of excrement and other matter resembling the conditions attending advanced stages of the ordinary rot."

One of the species instrumental in causing potato scab and rot is believed to be a new or undescribed species to which Mr. Hopkins has given the name potato scab gnat (*Epidapus scabies*). The larvæ of this species are "slender, white bodied, smooth and shining worms with jet-black heads," and attain a length of eighteen hundredths of an inch. "These worms move about freely through damp soil and the substance upon which they feed and at times are quite active. They may occur singly or in great numbers in the substance infested by them. They spin a web wherever they go, and if the substance on which they are feeding is exposed to the light they will quickly spin a web over the exposed surface in order to conceal themselves beneath it."

Another species having similar habits belongs to the genus *Sciara* of the same family.

The same conditions which promote or prevent the growth of the potato scab fungus are favorable or unfavorable to the fungus gnats and therefore the same remedies may be used for their repression.

Detailed accounts of these investigations will be published by the West Virginia Station.

THE SAN JOSÉ SCALE IN THE EAST.—This Department will issue in a few days an emergency bulletin treating of the San José scale of California, sometimes called the pernicious scale (*Aspidiotus perniciosus*). This insect, which is the most serious insect enemy which growers of fruit in California have to contend with, has within the past year been introduced into the East, probably, it is thought, through nursery stock imported from California. So far it has been discovered in only three localities, in Virginia, Maryland, and Florida. In one orchard in Maryland it has already severely injured 300 peach and apple trees. The Department urges upon all fruit-growers the importance of making immediate examination of their orchards to ascertain whether or not this insect has made its appearance. The insect is described as a small, flat, round scale, a little lighter in color than the bark of the tree and found most abundantly upon the younger limbs and twigs. At this season of the year it is about an eighth of an inch or less in diameter. In the middle of each scale is a small, elevated, shiny, black, rounded point. Sometimes the center of the scale appears yellowish. The wood underneath the scale is apt to be discolored and sometimes purplish. When the insect is abundant the bark is completely hidden by

a close layer of the scales, which give the appearance of a slight discoloration or a light roughening of the bark. No other scale upon apple, pear, peach, cherry, or plum trees possesses these characteristics, and it is believed that the insect will be readily distinguished when present.

DAIRYING IN NORWAY.—Thirty-two cheese factories and 396 creameries were in operation during 1893. Most of the creameries produced spiced skim milk cheese, as well as butter, but, owing to the decline in price of this cheese and the decreasing demand for it, many have begun to use the skim milk and buttermilk for swine feeding.

The exportation of butter and cheese from Norway during the last four years was as follows:

Exportation of butter and cheese.

	1890.	1891.	1892.	1893.
	Kg.	*Kg.*	*Kg.*	*Kg.*
Butter	211,100	348,755	488,134	*514,315
Cheese	78,059	45,770	72,220	*81,025

* Nine months.

The exports of butter have increased rapidly during the last four years. This has been due to the increase in the production of milk and in the number of creameries; and to the increased use of oleomargarin in the country households, so that more and more of the new milk is sent to creameries. The prices paid for new milk by creameries and cheese factories ranged between $1.26 and $1.52 per 100 pounds. The milk-condensing factories at Hamar and Sannesund paid from $1.18 to $1.60 per 100 pounds, an average of $1.43.

The average market prices for butter and cheese in Christiania during the last four years are given in the following table:

Average market prices for dairy products per pound.

	1890.	1891.	1892.	1893.
	Cents.	*Cents.*	*Cents.*	*Cents.*
Creamery butter	30.0	31.7	32.0	30.8
Cheddar cheese	19.5	19.2	18.2	17.8
Swiss cheese	15.5	15.3	14.3	14.3
Spiced skim milk cheese	6.6	6.6	6.2	6.1

A TEXT-BOOK ON DAIRYING.—L. L. Van Slyke, of New York State Station, has in preparation a work on the "Elements of the Science of Dairying," intended as a text-book for dairy schools, which it is hoped to complete within a year.

MINNESOTA BOTANICAL STUDIES.—Bulletin No. 9, part II, Geologic and Natural History Survey of Minnesota, contains the following articles: Nitrogen assimilation by *Isopyrum biternatum*, D. T. MacDougal; On the morphology of hepatic elaters, J. E. Tilden; Revised descriptions of the Minnesota *Astragali*, E. P. Sheldon; Synonymy of the North American species of *Juncodes* and nomenclatural notes on *Astragalus*, E. P. Sheldon; Further extension of plant ranges, E. P. Sheldon; Determinations of Minnesota lichens, W. D. Frost.

PERSONAL MENTION.—W. Scott has been appointed director of the forests and botanic gardens of Mauritius.

Robert Bently, professor of botany in the Pharmaceutical School of London, and an author of wide repute in pharmaceutical botany, died recently.

Dr. J. C. Hasskarl, who first successfully transferred cinchona to Java, died at Clive January 5.

Federigo Delpino, formerly professor in the University of Bologna, has been chosen professor of botany and director of the botanic gardens at the University of Naples.

Carl Avetta, of the University of Rome, has been elected professor extraordinary of botany and director of the botanic gardens at the University of Parmi.

Recent articles by station workers.—The following articles by station workers have recently appeared: In *American Florist* (*vol. IX*): A blight of ornamental ferns, B. D. Halsted, p. 766; an orchid leaf blight, B. D. Halsted, pp. 766, 767.

In *Erythea* (*vol. II*): Synonymy of *Eragrostis eragrostis*, A. S. Hitchcock, pp. 37–39.

In *Garden and Forest* (*vol. VII*): The quality of the modern-process maple sugar, C. S. Plumb; On the flavor of maple sugar, J. L. Hills, p. 128; Plum curculio on the apple, J. B. Smith, p. 104.

In *Journal American Chemical Society* (*vol. XVI, No. 3*): Recent progress in the analysis of cattle foods, F. W. Woll, pp. 174–178; Notes on the Grandeau method for the determination of humus in soils, H. Snyder, pp. 210–213.

In *Journal Cincinnati Society of Natural History* (January, 1894): Observations on some *Entomophthoreæ*, F. M. Webster, pp. 173–177.

In *Torrey Bulletin* (*vol. XXI*): Germination of the spores of *Cerebella paspali*, G. F. Atkinson, pp. 127, 128; Shrinkage of leaves in drying, B. D. Halsted, pp. 129, 130.

In *Zoe* (*vol. IV*): Lower California grasses, F. Lamson-Scribner, pp. 385–393.

In *Country Gentleman* (March): Commercial valuation of fertilizers, P. Collier, pp. 243, 244.

LIST OF PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE.

APRIL, 1894.

Farmers' Bulletin No. 15.—Some Destructive Potato Diseases: What They Are and How to Prevent Them.

Farmers' Bulletin No. 16.—Leguminous Plants for Green Manuring and for Feeding

WEATHER BUREAU:

Monthly Weather Review, February, 1894.

DIVISION OF AGRICULTURAL SOILS:

Circular No. 1.—Announcement.

DIVISION OF ENTOMOLOGY:

Circular No. 3, second series.—An Important Enemy to Fruit Trees.

DIVISION OF VEGETABLE PATHOLOGY:

Bulletin No. 5.—The Pollination of Pear Flowers.

DIVISION OF STATISTICS:

Report No. 113 (new series), March, 1894.—Report of the Statistician.

Report No. 114 (new series), April, 1894.—Report of the Statistician.

OFFICE OF EXPERIMENT STATIONS:

Experiment Station Record, vol. v, No. 8.

OFFICE OF ROAD INQUIRY:

Bulletin No. 3.—Improvement of the Road System of Georgia.

Bulletin No. 4.—Report on Road-Making Materials in Arkansas.

LIST OF STATION PUBLICATIONS RECEIVED BY THE OFFICE OF EXPERIMENT STATIONS.

APRIL, 1894.

AGRICULTURAL EXPERIMENT STATION OF THE UNIVERSITY OF ARIZONA:

Bulletin No. 11, December, 1893.—Pumping Water for Irrigation.

ARKANSAS AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 26, January, 1894.—Spraying Apple Trees; Spraying for Apple Scab; Spraying for Bitter Rot; Prevalence in the State of Apple Scab and Bitter Rot; Variety of Apples in the State Reported as Surest Bearers; Some Apples Adapted to all Sections of the State; Arkansas Seedling Apples.

THE CONNECTICUT AGRICULTURAL EXPERIMENT STATION:

Seventeenth Annual Report, 1893, part IV.

Bulletin No. 118, March, 1894.—A Provisional Bibliography of the More Important Works Published by the U. S. Department of Agriculture and the Agricultural Experiment Stations of the United States, from 1886 to 1893, inclusive, on Fungus and Bacterial Diseases of Economic Plants.

THE DELAWARE COLLEGE AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 22, December, 1893.—The Preparation of Ammoniacal Solution of Copper Carbonate.

AGRICULTURAL EXPERIMENT STATION OF THE UNIVERSITY OF ILLINOIS:

Bulletin No. 30, March, 1894.—Blackberries and Raspberries: Variety Tests and Management.

Bulletin No. 31, March, 1894.—Corn and Oats Experiments, 1893.

Bulletin No. 32, April, 1894.—An Acid Test of Cream.

AGRICULTURAL EXPERIMENT STATION OF INDIANA:

Bulletin No. 50, April, 1894.—Field Experiments with Corn and Oats.

KANSAS AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 45, December, 1893.—Experiments with Corn.

LOUISIANA AGRICULTURAL EXPERIMENT STATIONS:

Bulletin No. 25 (second series).—Tobacco.

Bulletin No. 26 (second series), February, 1894.—Sugar Cane.

MASSACHUSETTS STATE AGRICULTURAL EXPERIMENT STATION:

Eleventh Annual Report, 1893.

HATCH EXPERIMENT STATION OF THE MASSACHUSETTS AGRICULTURAL COLLEGE:

Meteorological Bulletin No. 63, March, 1894.

EXPERIMENT STATION OF MICHIGAN AGRICULTURAL COLLEGE:

Bulletin No. 103, February, 1894.—Peach and Plum Culture in Michigan.

Bulletin No. 104, February, 1894.—A Year Among Fruits.

Bulletin No. 105, February, 1894.—Michigan Fruit List.

Bulletin No. 106, February, 1894.—Strawberries and Raspberries.

AGRICULTURAL EXPERIMENT STATION OF THE UNIVERSITY OF MINNESOTA:

Bulletin No. 31, December, 1893.—Practical Rations for Lambs; Lambs *vs.* Wethers for Fattening; Valuation of Wheat Screenings; Varieties of Wheat, Oats, and Corn; Methods of Planting Wheat, Oats, and Potatoes; Depths to Sow Oats and Wheat, and Time to Sow; Heavy *vs.* Light Oats for Seed; Methods of Preparing Land for Oats.

AGRICULTURAL EXPERIMENT STATION OF THE UNIVERSITY OF MINNESOTA—Continued.

Bulletin No. 32, December, 1893.—Late Blight and Rot of the Potato; Potato Scab; Cross Fertilization of Grapes; Conservation of Moisture in the Soil; Notes on Varieties of Fruits.

MISSISSIPPI AGRICULTURAL EXPERIMENT STATION:

Sixth Annual Report, 1893.

Bulletin No. 28, January, 1894.—The Horn Fly.

MISSOURI AGRICULTURAL COLLEGE EXPERIMENT STATION:

Bulletin No. 20, January, 1893.—Soils and Fertilizers, part 2.

Bulletin No. 23, October, 1893.—Grape Culture.

AGRICULTURAL EXPERIMENT STATION OF NEBRASKA:

Bulletin No. 33, April 16, 1894.—Meteorological Observations for 1893.

NEVADA AGRICULTURAL EXPERIMENT STATION:

Sixth Annual Report, 1893.

Bulletin No. 22, December, 1893.—Nevada Weeds, II.

AGRICULTURAL EXPERIMENT STATION OF NEW MEXICO:

Fourth Annual Report, 1892–'93.

NEW YORK AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 69, March, 1894.—Vegetables Grown for Exhibition.

CORNELL UNIVERSITY AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 64, March, 1894.—On Certain Grass-Eating Insects.

Bulletin No. 65, April, 1894.—Tuberculosis in Relation to Animal Industry and Public Health.

NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION:

State Weather Service Bulletin No. 52, January 31, 1894.—Meteorological Summary for January, 1894.

State Weather Service Bulletin No. 53, February 28, 1894.—Meteorological Summary for February, 1894.

Special Bulletin No. 19, April 7, 1894.—Fertilizer Analyses and the Fertilizer Control.

NORTH DAKOTA AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 13, April, 1894.—Rational Selection of Wheat for Seed; Typhoid Fever.

OHIO AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 51, December, 1893.—Miscellaneous Entomological Papers.

THE PENNSYLVANIA STATE COLLEGE AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 25, October, 1893.—Small Fruits in 1893.

RHODE ISLAND AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 27, March, 1894.—Leaf Blight of the Pear; Raspberries; Distribution of Plants.

SOUTH DAKOTA AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 37, December, 1893.—Tomatoes.

AGRICULTURAL EXPERIMENT STATION OF UTAH:

Fourth Annual Report, 1893.

VERMONT AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 36, 1893.—Potato Blight and Remedies.

Bulletin No. 37, 1893.—Annual Report of the Director, part I.

Bulletin No. 38, 1893.—Annual Report of the Director, part II.

Bulletin No. 39, 1893.—Annual Report of the Director, part III.

WYOMING AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 17, March, 1894.—Crop Report for 1893; Cost and Profit of Growing Wheat; Sugar Beets; Garden Vegetables and Tobacco; Progress Report on Fruits and Trees; Meteorology for 1893.

DOMINION OF CANADA.

DEPARTMENT OF AGRICULTURE:

Report of Experimental Farms, 1893.

ONTARIO DEPARTMENT OF AGRICULTURE:

Special Bulletin, April, 1894.—Common Country Roads.

ONTARIO AGRICULTURAL COLLEGE EXPERIMENT STATION:

Bulletin No. 92, March 26, 1894.—Diseases Affecting the Grape.

PUBLICATIONS OF THE OFFICE OF EXPERIMENT STATIONS.

The Office of Experiment Stations issues three classes of publications for general distribution:

(1) Experiment Station Record and (2) Bulletins, which are more or less technical. It is the practice to send to persons applying for them one or more numbers, from which they may judge of their usefulness, but not to place any names upon the mailing list until after receipt of applications on special blanks furnished by the Office.

(3) Farmers' Bulletins, which are brief and popular in character, and are sent on application. These bulletins are issued as part of the general series of Farmers' Bulletins of the Department of Agriculture.

The following publications have been issued:

Experiment Station Record, vol. I, 6 numbers; vol. II, 12 numbers; vol. III, 12 numbers and index; vol. IV, 12 numbers, including index; vol. V, Nos. 1–8. Copies of the Station and Department publications abstracted in the Record can, in many instances, be obtained on application.

Bulletins.—No. 1, Organization and History of the Stations; No. 2, Digest of Annual Reports of the Stations for 1888, in two parts; No. 3, Report of Meeting of Horticulturists at Columbus, Ohio, June, 1889; No. 4, List of Station Horticulturists and Outline of their Work; No. 5, Organization Lists of Stations and Colleges, March, 1890; No. 6, List of Station Botanists and Outline of their Work; No. 7, Proceedings of the Fifth Annual Convention of the Association of American Agricultural Colleges and Experiment Stations, Washington, D. C., August, 1891; No. 8, Lectures on Investigations at Rothamsted Experimental Station; No. 9, The Fermentations of Milk; No. 10, Meteorological Work for Agricultural Institutions; No. 11, A Compilation of Analyses of American Feeding Stuffs; No. 12, Organization Lists of the Agricultural Experiment Stations and Agricultural Schools and Colleges in the United States, June, 1892; No. 13, Organization Lists of the Agricultural Experiment Stations and Agricultural Schools and Colleges in the United States, April, 1893; No. 14, Proceedings of a Convention of the National League for Good Roads, January, 1893; No. 15, Handbook of Experiment Station Work; No. 16, Proceedings of the Sixth Annual Convention of the Association of American Agricultural Colleges and Experiment Stations, New Orleans, Louisiana, November, 1892; No. 17, Suggestions for the Establishment of Food Laboratories; No. 18, Assimilation of Free Atmospheric Nitrogen by White and Black Mustard; No. 19, Organization Lists of the Agricultural Experiment Stations and Agricultural Schools and Colleges in the United States, January, 1894.

Miscellaneous Bulletins.—No. 1, Proceedings of Knoxville Convention of Association of Agricultural Colleges and Stations, January, 1889; No. 2, Proceedings of Washington Convention of the Association, November, 1889; No. 3, Proceedings of Champaign Convention of the Association, November, 1890. (Series discontinued.)

Farmers' Bulletins.—No. 1, The What and Why of Agricultural Experiment Stations; No. 2, Illustrations of the Work of the Stations; No. 9, Milk Fermentations and their Relation to Dairying; No. 11, The Rape Plant; No. 14, Fertilizers for Cotton; No. 16, Leguminous Plants for Green Manuring and for Feeding.

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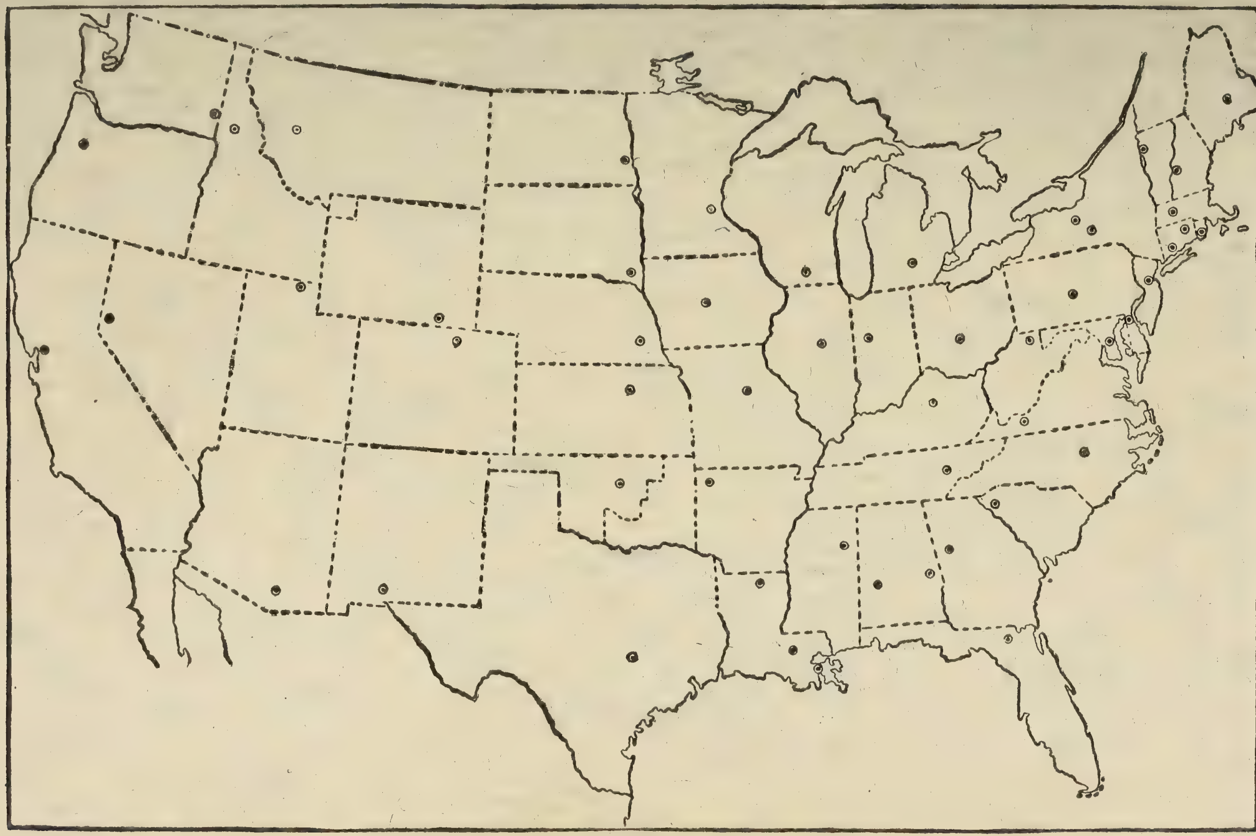

The Agricultural Experiment Stations in the United States.

R. Kent Beattie

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U. S. DEPARTMENT OF AGRICULTURE

OFFICE OF EXPERIMENT STATIONS

Vol. V No. 10

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U. S. DEPARTMENT OF AGRICULTURE

OFFICE OF EXPERIMENT STATIONS

Vol. V No. 10

EXPERIMENT STATION

RECORD

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ENTOMOLOGY.

ANIMAL PHYSIOLOGY.

FOODS—ANIMAL PRODUCTION.

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EXPERIMENT STATION RECORD.

VOL. V. NO. 10.

Elsewhere in this number of the Record an abstract is given of part five of the bulletins on cheese-making issued by the New York State Station. This bulletin concludes the series on this subject devoted to the experiments of 1893. These investigations were commenced in 1891, and three seasons of work have been completed. They comprise probably the most extensive systematic study of the subject ever made, and have given us much more definite knowledge as to the losses in cheese-making, the effect of various milk ingredients in the process, and their value in determining the yield and the quality of the product. Of late the work has been carried on with the coöperation of the New York Dairy Commissioner. Experiments have been made at the station at Geneva and at a number of cheese factories in different parts of the State. They have included milk of varying richness produced by a very large number of cows in different stages of the period of lactation and at different seasons of the year. The amount of work involved has been enormous, as will be apparent from the statement that the chemical work during 1892 and 1893 included 11,561 determinations, made in triplicate.

One point which has been very forcibly brought out by these investigations is that the fat in the milk plays a most important part in determining the yield and the quality of the cheese. As the fat in the milk increased the yield of green cheese increased, (1) because the proportion of the fat which was incorporated into the cheese was actually larger in the case of rich milk; (2) because more casein was incorporated into the cheese for the reasons that the milk contained more casein and that very little casein was lost in the process of manufacture; and (3) because more water was retained in the cheese, owing to the increased fat and casein.

The loss of fat in cheese-making was found to be quite independent of the amount of fat in the milk; and the amount of green cheese made for each pound of fat in the milk varied but slightly in the case of milk of varying richness.

It appears, then, that the composition of the cheese is very largely governed by the composition of the milk from which it is made. Skimming milk increases the proportion of casein to fat in the milk and likewise in the cheese made from such milk. The effect of adding cream to normal milk is to make the amount of fat larger in proportion to the casein, and the same effect is produced in the cheese made from such milk. Furthermore, "it has been fairly established that the rela-

tion of fat to casein in cheese largely governs the commercial quality and, therefore, the market value of cheese, within certain limits." Hence it appears that milk rich in fat is quite as desirable for cheese-making as for butter-making. The statement has even been made of late that "the so-called cheese cow, *i. e.*, the cow which is good especially for cheese rather than for butter, does not exist, and that wherever a cow is found that is good for cheese-making purposes, the milk of that cow is equally good for the manufacture of butter."* The results of the Columbian dairy test point in the same direction.

If milk differs as widely in its value for cheese-making as for butter-making, the injustice resulting from paying for milk at cheese factories according to weight alone is not less than arises from the similar practice at creameries, which is being quite rapidly corrected.

The investigations above mentioned have furnished abundant evidence that the fat in milk is a reliable index to its cheese-producing value, and may be used as a basis of paying for milk without injustice to the producers or the factories. The New York Station urges the adoption of such a system, and details a method for carrying it out similar to the "relative value" plan proposed by Prof. Patrick for creameries. Much credit is due the station for showing the adaptability of the scheme to cheese factories. Nothing could do more to encourage the general improvement of dairy herds than the universal adoption of such a system at both creameries and cheese factories."

In a pamphlet entitled Some Notes on Agricultural Education, compiled during a visit to Denmark, Mr. M. J. R. Dunstan, director of agricultural education at Nottingham, England, asks and answers the question, "Why should Denmark supply us with a commodity which we are able to produce at home?" His answer is: "In my opinion the supremacy of Denmark in this industry [dairying] is due, in a great measure, to the education of every one concerned, from the farmer to his dairy maid, and also to the system of coöperation adopted."

He then reviews the progress in dairying and in dairy education in Denmark, showing that the two have gone hand in hand. This leads him to consider the application of this sort of education to England, and he asks, "Can not we, in this country, develop a similar interest, and by paying more attention to what has been termed 'women's work,' avoid subsidizing foreigners to produce an article we lack in a great measure the enterprise to produce ourselves?"

From his personal observations Prof. Dunstan concludes that "Denmark is not suited for dairying any more than our county of Norfolk," which it is said to resemble closely in quality and extent of grass land.

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* Vt. Sta. Report for 1892, p. 123.

A REVIEW OF RECENT WORK ON DAIRYING.

E. W. ALLEN.

Within the past few years the activity in investigation bearing on dairying has materially increased and has developed along more varied lines. The bacteriology of the dairy has become a field for special study, and the wide application of its teachings in butter-making and cheese-making, as well as in other dairy work, is already apparent. The processes involved in the manufacture of dairy products are being studied step by step to determine the function and influence of the several milk constituents, the means of economizing them, and of securing a more uniform product. Again, the nature and properties of the different constituents of milk have been the subject of investigations which have, in many cases, materially increased our knowledge. The study of the relation of food to milk and to the products made from it, has been continued and a number of new phases developed.

In view of the extent of the investigations in dairying it has seemed desirable to bring the material together for convenience in studying it, as well as in the interest of future investigation. In the following pages a review and bibliography are given of the literature of the subject for the past two years, grouped under the following general headings: (1) Composition and properties of milk and its products, (2) special studies on milk, (3) secretion of milk, (4) effect of various factors on milk production, (5) effect of food on butter, (6) dairy bacteriology, (7) sterilizing and pasteurizing milk, (8) butter-making, (9) cheese-making, (10) milk supply, (11) dairy farming, (12) dairy technology, and (13) recent literature. Papers on methods of analysis, inspection, etc., have not been included in this review.

A very wide range of periodicals has been searched in the effort to make the survey as nearly complete as practicable, and while there are many difficulties in the way of making an absolutely complete bibliography for a given period, it is believed that no serious omissions have been made. The object being to present a review of the work, as well as a bibliography, brief abstracts of most of the articles are given and reference is made, as far as practicable, both to the original papers and to abstracts of them published elsewhere.

The article will be published in two parts, the first part embracing the first five divisions.

COMPOSITION AND PROPERTIES OF MILK AND ITS PRODUCTS.

Milk, skim milk, and buttermilk.—The large number of analyses of these materials made at the experiment stations in this country furnish interesting data for the study of the composition of American dairy products. The Vermont Station[1] has compiled the results of all complete American analyses up to 1891, showing the proportion of both food and fertilizing ingredients and the distribution of these in butter-making and cheese-making. The average composition is as follows:

Average of American analyses of milk and dairy products.

	Milk ingredients.						Fertilizing ingredients.			
	Total solids.	Fat.	Casein	Albumen.	Milk sugar.	Ash.	Nitrogen.	Phosphoric acid.	Potash.	Value per ton.
	P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	
Whole milk, average	13.00	4.00	2.60	0.70	4.95	0.75	0.53	0.19	.175	$2.17
Whole milk, maximum	17.00	8.00	3.60	0.90	5.50	0.90	......	......	......	......
Whole milk, minimum	10.00	2.00	1.60	0.40	4.00	0.60	......	......	......	......
Skim milk	9.75	0.30	2.75	0.75	5.15	0.80	0.56	0.20	.185	2.31
Cream	25.95	18.80	2.00	0.50	4.15	0.50	0.40	0.15	.130	0.66
Buttermilk	9.50	0.50	2.40	0.60	5.30	0.70	0.48	0.17	.158	1.98

"In a dairy of 20 cows giving 4,000 pounds of milk apiece yearly, the total fertilizing value of the milk for a year will approximate $86.80, all of which is lost to the farm if the whole milk is sold; two thirds if cheese is sold and whey retained; one sixth if butter is sold and the buttermilk left at the factory; and one hundredth only if butter is sold and both skim milk and buttermilk fed upon the farm."

The Massachusetts State Station[2] gives a compilation of analyses made at that station, from which the following is taken:

Analyses of dairy products at Massachusetts State Station.

	Number of analyses.	Total solids.			Fat.			Curd (average).	Ash (average).
		Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.		
		Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Whole milk	1,738	18.27	10.58	13.49	7.54	1.72	4.14	3.20	0.70
Skim milk	328	10.40	7.68	9.48	1.02	0.05	0.39	3.53	0.80
Buttermilk	31	9.86	6.83	8.33	0.38	0.11	0.27	2.79	0.80
Cream (from Cooley creamer)	176	32.78	19.93	26.47	25.00	13.11	17.98	....	0.62

P. Collier[3] reports analyses of the milk of a number of breeds of cows for one entire period of lactation (the first). The averages for each breed, representing an aggregate of 930 analyses, are as follows:

[1] Vt. Sta. Report for 1891, pp. 118, 119; abs. in E. S. R., vol. IV, p. 486.

[2] Mass. State Sta. Report for 1893, p. 376.

[3] N. Y. State Sta. Report for 1891, p. 139; abs. in E. S. R., vol. IV, p. 263.

Average composition of milk of different breeds.

Breed.	Number of analyses.	Water.	Total solids.	Solids-not-fat.	Fat.	Casein.	Milk sugar.	Ash.	Nitrogen.	Daily milk yield.
		Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Lbs.*
Holstein-Friesian	132	87.62	12.39	9.07	3.46	3.39	4.84	0.735	0.540	22.65
Ayrshire	252	86.95	13.06	9.35	3.57	3.43	5.33	0.698	0.543	18.40
Jersey	238	84.60	15.40	9.80	5.61	3.91	5.15	0.743	0.618	14.07
American Holderness	124	87.37	12.63	9.08	3.55	3.39	5.01	0.698	0.535	13.40
Guernsey	112	85.39	14.60	9.47	5.12	3.61	5.11	0.753	0.570	16.00
Devon	72	86.26	13.77	9.60	4.15	3.76	5.07	0.760	0.595	12.65
Average		86.37	13.64	9.40	4.24	3.58	5.09	0.731	0.534	16.20

"According to the above table the ash varies least among the above constituents of milk, sugar next, then casein, and fat by far in excess of all, varying over four times as much as casein."

The average composition of the total solids was as follows:

Average composition of total solids of milk.

Breed.	Total solids.	Solids-not-fat.	Fat.	Casein.	Sugar.	Ash.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Holstein-Friesian	100	73.2	28.0	27.4	39.1	5.93
Ayrshire	100	71.6	27.3	26.3	40.8	5.34
Jersey	100	63.6	36.4	25.4	33.4	4.82
American Holderness	100	71.9	28.1	26.8	39.7	5.53
Guernsey	100	64.9	35.1	24.7	35.0	5.16
Devon	100	69.7	30.1	27.3	36.8	5.52
Average	100	69.2	30.8	26.3	37.5	5.38

The variation in the percentage of fat in the total solids is larger than for any other constituent.

The same author[1] gives the detailed record for the second period of lactation of cows of the above breeds, without averages.

In connection with investigations in cheese-making during the seasons of 1892 and 1893, L. L. Van Slyke[2] analyzed samples of milk representing 5,000,000 pounds, the product of 15,000 cows, mostly natives and grades. Following is the range and the average of composition:

Composition of milk of New York herds.

	Water.	Total solids.	Fat.	Casein.	Albumen.	Milk sugar, ash, etc.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Least	86.09	11.17	3.04	1.93	0.47	5.32
Greatest	88.53	13.91	4.06	3.00	0.87	6.37
Average	87.33	12.67	3.75	2.46	0.68	5.78

The relation between albumen and casein ranged from 1:2.6 to 1:5.58, and averaged 1:3.66. The relation between fat and casein ranged from

[1] N. Y. State Sta. Report for 1892, p. 62.

[2] N. Y. State Sta. Bul. No. 65; abs. in E. S. R., vol. v, p. 893.

1:1.38 to 1:1.78, and averaged 1:1.52. On the basis of these analyses the author[1] makes the following statements for normal milk:

(1) The relation of casein to albumen is more or less variable.

(2) The fat is rarely less than the casein and albumen. The average proportion is 1.2 pounds of fat to 1 pound of casein and albumen, or 1.5 pounds of fat to 1 pound of casein.

(3) A milk containing less than 1.3 pounds of fat for each pound of casein has, in all probability, been skimmed.

(4) Milk with 3 per cent of fat will usually contain considerably less than 12 per cent of solids, which is at variance with the legal standard adopted in New York. This proportion holds only in the case of partially skimmed milk.

H. D. Richmond[2] reports analyses of over 13,000 samples of milk as received for delivery to customers during 1892. The average composition was, total solids 12.71 per cent, fat 3.91, solids-not fat 8.8; specific gravity 1.032. This average is said to be the lowest yearly average yet observed. The report by the same author[3] for 1893 includes analyses of over 28,000 samples of milk and 1,121 of cream. The average composition of the milk was total solids 12.68 per cent, fat 3.91, solids-not-fat 8.77; specific gravity 1.0318. The highest percentages of solids and fat occurred in November in 1892 and in October in 1893, and the lowest in both years in June. The cream averaged 47.5 per cent of fat.

Beer[4] gives the following average for 1892 and 1893 for milk received at the creamery at Arnheim, Holland: Total solids 11.83 per cent; fat 3; specific gravity 1.0321. The lowest monthly average for fat was 2.85 and the highest 3.18 per cent. The cows were mostly Dutch.

Analyses of milk and butter, and tables showing the distribution of milk in making cheese from normal milk, from mixed cream and milk, and from skimmed milk, have been reported by H. Snyder;[5] and the fat content of the milk of Mecklenburg herds has been studied by P. Vieth.[6]

Analyses of Guernsey and Holstein milk are given by C. A. Goessmann,[7] and analyses of a number of samples of milk and cheese are reported by A. Stift.[8] Analyses in 1893 of 1,400 samples of milk sent to the Chemical and Seed Control Station at Kalmar, Sweden,[9] showed the average for the year to be 3.53 per cent of fat.

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[1] Jour. Amer. Chem. Soc., 15 (1893), pp. 645-650.

[2] Analyst, 1893, p. 50; abs. in E. S. R., vol. IV, p. 773.

[3] Analyst, 1894, pp. 73-87.

[4] Milch Ztg., 22 (1893), p. 460.

[5] Minn. Sta. Bul., No. 27; abs. in E. S. R., vol. IV, p. 750.

[6] Milch Ztg., 22 (1893), pp. 274, 275.

[7] Mass. State Sta. Report for 1892, pp. 57-61; abs. in E. S. R., vol. V, p. 207.

[8] Ztschr. Nahr. Untersuch. und Hyg., 6 (1892), p. 454; abs. in Chem. Ztg., 16 (1892), Repert., p. 366.

[9] Report for 1893 of Chemical and Seed Control Station at Kalmar, Sweden, pp. 28.

C. B. Cochran[1] considers the relation of milk, skim milk, and whey in the light of its utility in detecting milk adulteration.

W. W. Cooke and J. L. Hills[2] report that the percentage of fat in the milk of single cows varied from day to day by 0.87 per cent, while the mixed milk of herds varied by 0.4 per cent. H. H. Dean[3] observed the variation in the percentage of fat in the milk of 8 cows from day to day. The widest variation in the morning's milk was 0.85 per cent, in the evening's milk 0.75 per cent, and in the mixed morning's and evening's milk 0.6 per cent.

Y. Melander[4] reports a test made for six days with 43 herds. In some cases the variation in fat from day to day amounted to 0.3 to 0.4 per cent, and in doubted cases the variation even reached 1 per cent. The author suggests that the variation may have been due in part to the cows not always being thoroughly stripped, and the interval between milkings being somewhat irregular. The variation between morning's milk and night's milk ranged from 0.2 to 0.7 per cent, and was usually above 0.5 per cent of fat. It follows that in sampling milk during an experiment, samples should be taken under the same conditions of milking, as far as possible, and at regular intervals from the last milking.

The variation in milk during the period of lactation has been observed by E. H. Farrington[5] and H. H. Dean.[6] The former found the butter fat to be the most changeable constituent, the percentage of solids-not-fat remaining quite uniform. The latter found that, dividing the lactation period into three parts of ninety-one days each, there was an increase in fat of only 0.17 per cent in the second period and 0.46 in the third period over that of the first period.

W. W. Cooke[7] details the results of extensive observations on the variation in milk under the heads of variation in quantity and quality during the period of lactation, during the first few weeks after calving, from year to year, and from one calving to the next; extreme variation during the period of lactation; and quality of milk at beginning and at end of lactation. He believes that two factors work to increase the variation in milk as lactation advances, viz, the shrinkage in quantity and, chiefly, being with calf. He finds that "on the average cows give the thinnest milk just after calving; it becomes slightly richer during the next two weeks, and then it holds almost uniform in quality for four or five months, after which it gradually increases in

[1] Jour. Amer. Chem. Soc., 15 (1893), pp. 347–351; abs. in E. S. R., vol. v, p. 354.

[2] Vt. Sta. Report for 1891, p. 61; abs. in E. S. R., vol. IV, p. 490.

[3] Ontario Agl. College Bul. No. 76; abs. in E. S. R., vol. IV, p. 611.

[4] Nord Mejeri Tidn., 1892, Nos. 48 and 49; abs. in Milch Ztg., 22 (1893), pp. 23, 24, and Chem. Centbl., 1893, I, No. 9, p. 435.

[5] Ill. Sta. Bul. No. 24; abs. in E. S. R., vol. IV, p. 940.

[6] Ontario Agr. College and Exptl. Farm Report for 1891, p. 175; abs. in E. S. R., vol. v, p. 638.

[7] Agl. Science, 7 (1893), pp. 253–265.

richness as the cow comes near to calving again, and by the ninth month from last calving is only about one seventh richer than it was during the earlier months." His data on the variation from one period of lactation to another indicate that "the milk of a cow is quite uniform in general quality through life." P. Collier[1] has compared the milk given by a number of breeds of cows in each month of the first and second periods of lactation.

Analyses of frozen milk are given by H. D. Richmond.[2] Analyses of the ice and the unfrozen portion showed that the ice was mostly water (96.23 per cent) with only 1.23 per cent of fat, the majority of the ingredients remaining in the unfrozen liquid. In delivering frozen milk to customers he states that the ice should be thrown away, as mixing it with the liquid portion will not give uniform normal milk; the solids will separate out.

A number of papers on abnormal milk have been published. W. W. Cooke and J. L. Hills[3] report the case of a Jersey cow milked up to the time of calving which gave milk instead of colostrum after calving. But few colostrum particles were found with the microscope in the first milking after calving and not many in succeeding milkings. They also mention the case of a registered Jersey which just before going dry gave milk with 28.43 per cent of solids, 14.67 per cent of fat, and 13.76 per cent of solids-not-fat. "This is probably the only milk analysis on record in which the fat is more than the solids-not-fat."

A number of notes on abnormal milk were read before the Society of Public Analysts.[4] Among these was the case of a cow at a fair which at first, when in a nervous condition, gave milk with 10.85 per cent of solids and 1.85 per cent of fat; and the next evening, when quiet and in a normal condition, gave milk with 12.75 per cent of solids and 3.64 per cent of fat. In the first instance the cow refused to give down her milk. In another case a cow seven months in milk gave milk with 8.83 per cent of solids, 2.73 per cent of fat, and 0.95 per cent of ash, having an unpleasant saline taste. Two cows at a fair gave milk with 19.5 and 16 per cent of solids and 11.06 and 7.37 per cent of fat, respectively. The richer milk was from a cow about three months advanced in her first period of lactation, which gave 6.6 pounds of milk at a milking. In the discussion of the bearing of these cases on prosecutions under the existing laws, milk was defined as "the normal secretion of the mammary glands of the cow;" abnormal milks were the products of abnormal animals.

E. von Raumer[5] mentions the case of a sample of market milk which was so low in composition as to lead the police and veterinarian to take

[1] N. Y. State Sta. Report for 1892, p. 139.
[2] Analyst, 1893, pp. 50–58; abs. in E. S. R., vol. IV, p. 774.
[3] Vt. Sta. Report for 1891, pp. 111–113; abs. in E. S. R., vol. IV, p. 487.
[4] Analyst, 1893, pp. 1–12.
[5] Abs. in Milch Ztg., 22 (1893), p. 804.

samples. Three samples ranged as follows: Solids 8.31 to 9.16 per cent, fat 0.25 to 1.55 per cent, milk sugar 3.82 to 4.10 per cent; specific gravity 1.0285 to 1.0310. The cow giving the milk was found to be sick, but the nature of the sickness is not stated.

The milk of a herd tested by F. J. Herz[1] had a normal fat content, but was low in specific gravity. Among the cows was one which had suffered from a disease of the udder. The milk of this cow had an unpleasant taste and gave a cream with reddish-yellow globules. Under the microscope it resembled colostrum somewhat; it fermented readily; the casein was curdled, and the curd rose to the surface, while the whey below was full of gas bubbles. At the end of five weeks the milk of this cow was wholly unlike normal milk, its strong alkaline reaction and abnormal curdling or behavior towards rennet being especially noticeable.

The phosphates of milk have been studied by Duclaux.[2] He states that phosphates exist in milk in soluble and insoluble forms. The insoluble phosphates consist of phosphates of iron, alumina, magnesium, and calcium. The soluble portion appears to be a mixture of tricalcium phosphate, sodium phosphate, and sodium citrate. The insoluble portion contains about twice as much lime and calcium phosphate as the soluble portion. The author found that so-called phosphate milk,[3] or milk supposed to have been increased in phosphates by feeding phosphate of lime, contained no more phosphates than other milk. The close agreement of the mineral constituents in the milks analyzed suggested that the addition of either soluble or insoluble phosphates to milk could be detected from the change it would cause in the relation of the soluble to the insoluble (suspended) phosphates.

A. Sartori[4] reports finding surphur to the extent of 0.043 per cent in cows' milk sold for infants. The milk was delivered in corked bottles and was examined about six hours after milking. The author is in doubt as to whether the sulphur found is entirely accounted for by that in the casein, and promises further contributions.

A substance called amyloid has been discovered in milk by F. J. Herz.[5] The substance was found by microscopic examination in milk, butter, and hard and soft cheese. It resembles starch, but differs from it in not being affected by boiling water, hot alcohol, or ether. He believes it is similar to an amyloid substance found by Virchow in the spleen, liver, kidneys, etc. The quantity of the substance in milk appears to be small, and it is not known whether it is a constant constituent or not.

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[1] Milch Ztg., 22 (1893), pp. 55, 56; abs. in Chem. Centbl., 1893, I, p. 705.

[2] Anal. Inst. Pasteur, 1893, pp. 2–17; abs. in Chem. Ztg., 17 (1893), and Repert., p. 79, and in E. S. R., vol. IV, p. 978.

[3] E. S. R., vol. III, p. 503.

[4] Chem. Ztg., 17 (1893), pp. 1070, 1138; abs. in E. S. R., vol. V, p. 343.

[5] Chem. Ztg., 16 (1892), p. 1524; abs. in E. S. R., vol. IV, p. 514.

The nuclein content of milk has been studied by Szontagh[1]. By artificially digesting cows' milk the author obtained regularly a nuclein containing 2.97 to 3.5 per cent of phosphorus. By continued digestion the nuclein diminished in amount and the phosphoric acid was recognized in solution. Nuclein could not be prepared from human milk by any known method. The author concludes that the casein of human milk differs from that of cows' milk by not containing any nucleoalbumen.

In a study of the proteids of cows' milk, A. R. Leeds[2] corroborated Duclaux's statement that casein was separated by filtering through a porcelain filter, and found that a large part of the lactalbumen remained on the filter. Both substances are in milk in colloidal form; only the starch-liquefying ferment galactazmase is in true solution in milk and passes the filter. The casein appears to be combined with alkali, and probably with lime and phosphoric acid. By sterilizing milk the above ferment is destroyed and coagulated; a part of the lactalbumen is also coagulated. Casein is not coagulated by heat, but is rendered more resistant towards rennet, pepsin, and pancreas, and this diminished digestibility of the proteids renders the fat more difficult to digest. Sterilizing, therefore, renders milk less digestible.

In considering the nomenclature of milk albuminoids H. D. Richmond[3] objects to Halliburton's suggestion to change the name of casein to caseinogen and retain casein as the name of the curd precipitated by rennet. He suggests instead "chemyo dys-caseose" for the curd produced by rennet, "pepto-proto-caseose" for that produced by pepsin, etc.

The cause of the color of milk is considered by C. A. Cameron.[4] He claims that the color is due to the large number of suspended casein coatings of the fat globules and not to the emulsion of fat and proteids. He extracted all but a trace of the fat from milk without changing the color. Buttermilk containing 0.3 to 0.6 per cent of fat is said to be whiter than whole milk which has been diluted with an equal amount of water, although the latter contains three times as much fat as the former.

H. J. Patterson[5] observed a slight decrease in the percentage of fat after samples had soured sufficiently to clabber. W. Thörner[6] studied the relation of the cream content to the fat content of milk and found the volume percentage of cream to be about twice the percentage of butter fat, although some variations were noted and the relation was not constant enough to be of value in testing milk.

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[1] Ungar. Arch. Med., 1892, p. 192; abs. in Chem. Centbl., 1893, I, p. 985, and E. S. R., vol. V, p. 246.

[2] Jour. Amer. Chem. Soc., 13, pp. 72–92.

[3] Chem. News, 67 (1893), p. 132.

[4] Chem. News, 66 (1892), p. 187.

[5] Agl. Science, 6 (1892), pp. 553–556.

[6] Chem. Ztg., 16 (1892), pp. 757, 758; abs. in E. S. R., vol. IV, p. 213.

The fat globules of milk have been the subject of a number of interesting investigations. P. Collier[1] records the results of a large number of determinations of the size of globules in the milk of different breeds. The size of the globules diminished as lactation advanced; that is, the relative number of large globules diminished and of small globules increased. He showed the relatively large size of the globules of Jersey and Guernsey milk as compared with those of Devon, American Holderness, Ayrshire, and Holstein milk. It was found that the relative number of the globules was 100 in the first quarter of the period of lactation, 137 in the second, 149 in the third, and 189 in the fourth; that is, the whole amount of milk given in the last quarter contained 89 per cent more fat globules than that given in the first quarter.

In a later article[2] he verifies the above statement and shows that the increase in the number of globules from first to last amounted to about 150 per cent, although there were marked differences in the case of different breeds.

O. Schnellenberger[3] determined the size and number of globules in the milk of different breeds of cows. He found that in general the number was larger the smaller the size of the globules. Milk from a fresh cow contained relatively more large globules and just before drying up relatively few large globules. In the course of the period of lactation there was a gradual decrease in the size of globules, accompanied by an increase in the number. The number per liter increased in one case from 2,480 milliards at the beginning to 4,449 milliards at the end of the milking period. With the change from dry feed to green feed in the spring there was an increase in the proportion and the number of large globules. Disease or sickness and the use of cows for draft when not accustomed to it had a marked effect in diminishing the number and size of globules.

The conditions influencing the number and size of fat globules have been the subject of an extensive investigation by F. W. Woll.[4] He finds that the size of the globules decreases with advancing lactation and the number in a given quantity of milk increases. The globules in colostrum are somewhat smaller and fewer than in normal milk. Succulent food appears to decrease the size and increase the number of the globules. Oats, bran, and linseed meal also appear to exert a definite influence on the size and number of the globules. Sickness and excitement affect the globules at once. Age is apparently without effect. Morning's milk has larger globules than evening's milk. The first part of the milking has fewer and smaller globules than the last part.

Butter.—The average given by W. W. Cooke[5] from a compilation of a large number of American analyses of butter is as follows: Water

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[1] N. Y. State Sta. Report for 1891, p. 143; abs. in E. S. R., vol. IV, p. 264.
[2] N. Y. State Sta. Report for 1892, pp. 153–162.
[3] Milch Ztg., 22 (1893), pp. 817–819; abs. in Chem. Centbl., 1894, I, p. 300.
[4] Agl. Science, 6 (1892), pp. 441–453, 510–528, 537–553.
[5] Vt. Sta. Report for 1891, p. 118; abs. in E. S. R., vol. IV, p. 486.

19.10, fat 85, casein 0.6, albumen 0.15, and ash 0.15 per cent. In 25 analyses at the Massachusetts State Station[1] the solids ranged from 87.05 to 92.89 and averaged 89.11 per cent; the fat ranged from 81.43 to 89.05 and averaged 83.95 per cent; the curd ranged from 0.51 to 0.89 and averaged 0.66 per cent; and the salt ranged from 3.46 to 6.45 and averaged 4.74 per cent.

The composition of a number of samples of French, Swedish, and English butter, salted and unsalted, is given by H. D. Richmond.[2] The Connecticut State Station[3] reports analyses of a number of samples of creamery and private dairy butter made in Connecticut. W. W. Cooke and J. L. Hills[4] show the variation in composition of butter made at a creamery on twenty-seven days. Under the uniform conditions prevailing the percentage of water varied from 10.43 to 14.70, averaging 12.35; and the percentage of fat ranged from 79.65 to 85.14, averaging 82.93. The butter had received but one working.

The proportion of water in butter has been the subject of much discussion of late, and the idea has been agitated in Germany and England of establishing a legal limit to the allowable water content. The general opinion abroad seems to be that 15 per cent of water is a fair limit and would work no injustice to either creameries or private dairies. The Prussian Minister of Agriculture has requested the agricultural experiment stations of that country to make special studies on the percentage of water in butter at different seasons of the year with a view to fixing a maximum for the water content.

A. H. Allen,[5] in an article on the proportion of water in butter, mentions finding over 20 per cent of water in a number of cases, the amount reaching 29 per cent in one case. He regards the standard adopted by the Society of Public Analysts in 1875 of 80 per cent of butter fat and 20 per cent of water, salt, and curd as "a perfectly proper limit."

H. D. Richmond[6] summarizes the results of analyses of 560 samples by himself and Vieth. Of these 84 per cent had between 11 and 15 per cent of water, a few (26) had more than this, and a much larger number had less. Vieth has fixed the maximum water content at 16 per cent and the author supports this. Only 5 out of the 560 samples had more than 16 per cent of water. In a paper before the German Dairy Association, Weigmann[7] showed the water content of butter made under his direction as it came from the churn, worked once, and when ready for market. As taken from the churn it had 17.5 to 19.5 per cent of water; worked once, 13 to 16; and ready for market, 11 to 12.25.

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[1] Mass. State Sta. Report for 1893, p. 376.

[2] Analyst, 1893, pp. 50–58; abs. in E. S. R., vol. IV, p. 774, and Analyst, 1894, Apr., p. 75.

[3] Conn. State Sta. Report for 1892, pp. 130, 131; abs. in E. S. R., vol. IV, p. 944.

[4] Vt. Sta. Report for 1891, p. 71; abs. in E. S. R., vol. IV, p. 492.

[5] Analyst, 1892, p. 107; abs. in E. S. R., vol. IV, p. 95.

[6] Analyst, 1894, pp. 16–18; abs. in E. S. R., vol. V, p. 815.

[7] Molk. Ztg., 8 (1894), p. 110.

In 18 samples from private dairies the water averaged 12.5 and did did not exceed 15.84 per cent. Creamery butter averaged 13.93 per cent, the maximum being 17.57. He concludes that with proper treatment the water content of butter need never exceed 15 per cent.

Graeff[1] reports analyses of 540 samples of butter. Of 86 samples made in March, 4 had over 14 and 1 over 15 per cent of water; of 88 samples made in April, 5 had over 14 and 1 over 16 per cent of water; of 70 samples made in May, 2 had over 14 and 1 over 15 per cent of water. Of the 540 samples analyzed, 6 had over 15 per cent and the maximum was 17 per cent of water. He studied the effect of different methods of treating the butter in 60 experiments, but found only slight variations. He believes that it is possible at all times to make butter containing less than 15 per cent of water. DuRoi[2] concludes from tests by himself and a review of other reliable tests that it is safe to fix 15 per cent of water as the maximum limit allowable, and that a carefully prepared well-worked butter need never exceed this. In another paper[3] he reports the examination of samples of butter from large estates, peasant farms, and coöperative creameries. The butter from estates averaged 13.36 per cent of water, the maximum being 15.12; that made by peasants ranged from 9.43 to 17.24 per cent, and that from coöperative creameries averaged 12.31, the maximum being 14 per cent. In experiments where the method of making was varied, 15 per cent was not exceeded under favorable conditions. He states that, as a rule, unsalted butter contains about 1 per cent more water than salted. There appears to be some doubt as to this latter point, however, as H. D. Richmond[4] reported in 1893 that unsalted French butter averaged 12.86 per cent of water and salted French butter averaged 13.98 per cent; and in 1894 that 35 samples of unsalted French butter averaged 13.65 per cent of water, while 28 samples of salted French butter averaged 11.61 per cent. W. S. Sweetser and R. J. Weld[5] report the rather surprising result that of two lots of the same butter, the unsalted butter had a higher water content than the salted.

W. Hofmeister[6] found that the butter made by peasants ranged in water content from 12.9 to 41.36 per cent; with one exception (41.36) it did not exceed 22.4; excluding the highest sample, the average was 15.9. A number of samples of creamery butter examined by him contained from 11.8 to 16.47, and averaged 13.55 per cent. The water content of Danish export butter was found by F. Friis[7] to range from 9 to 20 and average 14.59 per cent. For creamery butter the range was

[1] Molk. Ztg., 8 (1894), p. 110.

[2] Molk. Ztg., 7 (1893), pp. 93, 94.

[3] Molk. Ztg., 8 (1894), pp. 127, 128.

[4] Analyst, 1893, p. 50, and 1894, p 75; abs. in E. S. R., vol. IV, p. 774.

[5] Agl. Science, 7 (1893), p. 547.

[6] Abs. in Milch Ztg., 23 (1894), p. 53.

[7] Nogle oplysninger om "Vand i Smör," Kgl. Vet. Landbohöjsk. Lab. Landökon Forsög, Circ., Mar. 12, 1893, pp. 4; abs. in E. S. R., vol. IV, p. 690, and Milch Ztg., 22 (1893), p. 257.

from 11 to 18 and the average 14.63 per cent. He concludes that the water content could be kept below 16 per cent on an average for the whole year. The percentage of water affects the quality of the butter, he states, making it inferior when it rises above the natural percentage and too dry when it is too low in water content.

Examination of 743 tubs of Swedish butter[1] from 219 different creameries, showed the range to be from 10.7 to 16.88 per cent of water and the average 13.86. Less than one sixth of the samples were above 15 per cent in water.

From a comparison of creamery and dairy butter for four years, F. Friis[2] found the difference to be very small, amounting to only 0.54 point in favor of the dairy butter. A larger proportion of the dairy butter fell in the four upper grades.

F. W. Morse[3] reports upon two abnormal butters. The butter of one cow had 16.5 per cent volatile fatty acids and of another 11.5. The iodine numbers were 39.6 and 36, respectively. Both butters were hard, light-colored, and had a lardy taste. The cows were in the twelfth and fourteenth months of lactation, respectively. To this and to the cotton-seed oil and cotton-seed meal in the food the author attributes the abnormity.

Butter fat has been separated by A. Pizzi[4] into liquid and solid glycerides by a very gradual cooling of the melted fat. The chemical and physical properties of both portions are described.

E. Koefoed[5] has determined the different kinds of acids in butter. In his list are oleic, stearic, palmitic, myristic, lauric, capric, caprylic, caproic, and butyric acids, and two which he describes only by formula. The per cent of each of these in butter fat was determined.

In a preliminary note on the characteristics of the large and small fat globules in milk, E. Gutzeit[6] mentions finding no material difference between the large and small globules in respect to color, specific gravity, melting point, index of refraction, volatile fatty acids, acid number, saponification equivalent, iodine number, and unsaponifiable substance. The observations were made on the globules in cream and skim milk and those in milk from fractional milking. Quite different from this is the result obtained by E. Klusemann[7] in an examination of butter made from large and small fat globules. He finds that the size of the globules affects the qualities of the butter. Butter made from large glob-

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[1] Tidskr. Landtmän, 15 (1894), pp. 73–75, and Nord. Mejeri Tidn. 9 (1894), pp. 79, 80; abs. in E. S. R., vol. V, p. 920.

[2] Abs. in E. S. R., vol. V, p. 721.

[3] Jour. Amer. Chem. Soc., 7, pp. 1, 2.

[4] Staz. Sper. Agr. Ital., 25 (1893), pp. 101–118.

[5] Bul. de Acad. Royal Danoise, 1891; abs. in Analyst, 1892, pp. 130–133, and E. S. R., vol. IV, p. 213.

[6] Milch Ztg., 22 (1893), p. 439; abs. in Vierteljahr. Chem. Nahr. u. Genussmtl. 8, p. 211.

[7] Inaugural Dissertation, Leipsic, 1893, pp. 58; abs. in Chem. Centbl., 1894, I, p. 646, and in E. S. R., vol. V, p. 1022.

ules had a richer color, better taste and consistency, lower melting point and point of crystallization, less insoluble fatty acids, and lower specific gravity than that made from small globules.

A. J. Swaving[1] concludes from a study of the volatile fatty acids in Holland butter that the formation of volatile fatty acids is dependent upon the food as well as upon the period of lactation, and that these acids increase or are maintained at a high point with the beginning of the pasturage season or a new period of lactation; as the season and the period of lactation advance the volatile fatty acids decrease. He suggests as the minimum limit volatile fatty acids equivalent to 19 c. c. of decinormal alkali per 5 grams of butter fat.

M. Schrodt and O. Henzhold[2] report studies on the butter of 10 cows for one year. They conclude that the content of volatile fatty acids is dependent upon the stage of lactation and is not affected by the food. With the advance of the milking period these acids gradually diminish. As a rule a lower content of volatile fatty acids is accompanied by a higher percentage of insoluble acids and the latter by an increased index of refraction. Some butters are characterized by a low amount of volatile fatty acids, and for this reason it is believed that the volatile fatty acids should not be relied on alone in butter inspection, but that the insoluble acids and the index of refraction should be determined as well. F. W. Morse[3] observed that "the volatile acids decreased and the iodine number increased as the period of lactation advanced."

A number of investigations have been made on the connection between rancidity and the volatile fatty acids, acid number, etc. E. von Raumer[4] kept pure butter fat for four years in a vessel covered lightly with filter paper, allowing the volatile substances to escape. The Reichert-Meissl number which was 26.85 in 1888 was 30.2 in 1892, and the rancidity at the latter date was 21.1° (Burstyn). The volatile fatty acids increased quite regularly with the age. Others have found the contrary to be true, but the author mentions that their observations have been on butter instead of on pure butter fat. Corbetta[5] found that as the rancidity of a number of samples of butter increased the volatile fatty acids decreased.

V. von Klecki[6] has studied the relation between rancidity and the acid number of butter. He finds that the acidity is chiefly due to the activity of bacteria, and not to the oxidation of butter fat. The acidity of butter is not a direct index to its rancidity; the conditions under which the butter has been kept must be known. Butter kept in the

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[1] Landw. Vers. Stat., 39, p. 127; abs. in E. S. R., vol. III, p. 125.

[2] Landw. Vers. Stat., 40, pp. 299–309; abs. in E. S. R., vol. IV, p. 92.

[3] N. H. Sta. Bul. No. 16; abs. in E. S. R., vol. IV, p. 263.

[4] Forschungsber. ü. Lebensmtl., 1, pp. 22, 23; abs. in Chem. Centbl., 1894, I, p. 118, and Milch Ztg., 22 (1893), p. 804.

[5] L'Ind. Lait., 18 (1893), p. 28.

[6] Leipsic, 1894, pp. 66; abs. in Chem. Centbl., 1894, I, p. 643, Milch Ztg., 23 (1894), pp. 186, 202, Molk. Ztg., 8 (1894), pp. 176, 177, and E. S. R., vol. V, p. 1023.

sunlight or in a warm place may become rancid without becoming "sour," for heat and sunlight are unfavorable to increase in acidity. The author makes some practical suggestions for keeping butter. Sigismund[1] finds that bacteria are to a large extent responsible for butter becoming rancid. He cites experiments by others showing that bacteria can not thrive in pure fat and intimates that impurities in butter favor its becoming rancid.

Arata[2] comes to the conclusion that the rancidity of a fat does not depend alone upon the amount of free fatty acids, but more on increasing oxidation of certain fatty acids. From feeding experiments made on himself he makes the general statement that strongly rancid butter is injurious to health.

Butter from goats' milk, obtained from Sweden, was found by E. Gutzeit[3] to contain 8.2 per cent of water, 86.5 of fat, 3.9 of salt and ash, and 0.9 of casein. The butter was of a whitish yellow color and had a rancid taste. The melting point of the fat was 35.4° C., the volatile fatty acids 25.2, and the iodine number 26.7.

Cheese.—Analyses of American-made full cream, pineapple, skim milk, Neufchatel, Fromage de Brie, Swiss, Old English, and Limburger cheese and of imported Roquefort cheese have been reported by the Connecticut State Station.[4] L. L. Van Slyke[5] gives analyses of a large number of green cheeses made at cheese factories in New York. The proportion of casein to fat in green cheese ranged from 1:1.27 to 1:1.6 and averaged 1:1.42. "The general results go to show that in cheese made from normal milk the amount of fat should never be less than 50 per cent of the cheese solids, and that cheese containing less than this proportion of fat has undoubtedly been made from skim milk."

In a paper on the composition of American Cheddar cheese L. L. Van Slyke[6] mentions the limits to the amount of water, fat, and casein and albumen; the relation of fat to casein in cheese made from normal milk, from skim milk, and from milk to which cream or fat has been added; and the changes in composition during ripening.

A. B. Griffiths[7] gives analyses of eight different kinds of English cheese, *i. e.*, Stilton, Cheddar, Gloucester, Leicester, Cheshire, Cotherstone, Dorset, and Wiltshire. The water ranged from 27.55 to 41.44 per cent, the fat from 27.56 to 37.93, and the casein from 21.68 to 31.

A. Maggiora[8] studied the changes in an overripe Italian cheese. He

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[1] Inaugural Dissertation, Halle; abs. in Molk. Ztg., 8 (1894), p. 3, and E. S. R., vol. V, p. 816.

[2] Ann. Inst. d'Igienedi, Roma, 2 (1893), p. 157; abs. in Centbl. Allg. Gesund., 12 (1893), p. 5.

[3] Milch Ztg., 22 (1893), p. 756; abs. in E. S. R., vol. V, p. 816.

[4] Conn. State Sta. Report for 1892, pp. 156, 157; abs. in E. S. R., vol. IV, p. 945.

[5] N. Y. State Sta. Bul. No. 65; abs. in E. S. R., vol. V, p. 895.

[6] Jour. Am. Chem. Soc., 15, pp. 605–610.

[7] Bul. Soc. Chim. Paris, 7–8, sér. 3, p. 282.

[8] Arch. Hyg., 14, p. 216; abs. in E. S. R., vol. IV, p. 98.

finds that the albuminoids decrease and the amides and ammonia increase as the cheese ages, large quantities of leucin, tyrosin, and ammonium salts being formed at the expense of the paracasein. Finally the cheese becomes little else than an aqueous solution of fatty acids, decomposed albuminoids, and a mass of bacteria and fungi.

L. Carcano[1] gives analyses of cheese made from separator skim milk and speaks of the value of such cheese as food. Gorgonzola cheese which had caused serious indigestion was examined by V. Malenchini[2] and found to contain *Spirillum tyrogenum*, which is said to produce ptomaines in cheese. The author believes other bacteria can cause ptomaines in cheese by their action on the materials during or prior to manufacture. His investigation is not yet completed.

C. Lepierre[3] examined a cheese made from sheep's milk, which had caused serious illness when eaten. He describes the products found, among which was a ptomaine of the formula $C_{16}H_{24}N_2O_4$. This, when fed to a guinea pig, caused diarrhea. He believes this ptomaine to have been the cause of the trouble.

The composition of whey is reported on by L. L. Van Slyke,[4] who gives the range and average composition of the whey obtained in a large number of cheese-making experiments. The solids ranged from 6.43 to 7.52 and averaged 6.96 per cent; the fat ranged from 0.23 to 0.55 and averaged 0.36, and the proteids ranged from 0.65 to 1.07 and averaged 0.84.

SPECIAL STUDIES ON MILK.

Under this heading are included studies on the reaction of milk, casein, the digestibility of milk, sheep's, goats', and mules' milk, colostrum, and miscellaneous studies on milk.

Reaction of milk.—This mooted question has been the subject of a study by G. Courant.[5] He finds that both human milk and cows' milk show an alkaline reaction with lacmoid and an acid reaction with phenolphthalein, but that the reaction is more marked in cows' milk. Casein forms three compounds with calcium or sodium, all of which are alkaline to lacmoid and neutral to phenolphthalein and are decomposed by water. The decrease of milk in acidity when diluted with water is a result of the decomposition of the calcium-casein compounds and the phosphates. The decrease in the alkalinity is caused only by the presence of calcium-casein compounds. By cooking, the alkalinity and the acidity of milk are both reduced. The change in the casein caused by adding rennet to milk has no connection with the

[1] Staz. Sper. Agr. Ital., 24, pp. 5–8; abs. in Chem. Centbl., 1893, I, p. 895.

[2] Ztschr. Nahr. Untersuch. u. Hyg., 7, p. 7; abs. in Chem. Centbl., 1893, I, p. 397.

[3] Compt. Rend., 118 (1894), pp. 476–478.

[4] N. Y. State Sta. Bul. No. 65; abs. in E. S. R., vol. V, p. 895.

[5] Arch. ges. Physiol., 50 pp. 109–165; abs. in Ber. deut. chem. Ges., 24, p. 975, and E. S. R., vol. III, p. 744.

reaction. In curdling with rennet the dicalcium-casein compound is precipitated.

J. Sebelien[1] states that the alkaline part of the amphoretic reaction of milk to litmus requires to neutralize it from 0.2 to 0.5 c. c. of decinormal sulphuric acid per 50 c. c. of milk. The alkalinity is often greater towards the close of the milking period. The acid part of the reaction to litmus required from 3 to 5 c. c. of decinormal alkali per 50 c. c. of milk. The "relative acidity" towards phenolphthalein he finds equal to 10 to 11 c. c. of decinormal alkali usually. Toward the end of the milking period it may sink to 8 to 10 c. c. In colostrum the acidity was equivalent to 15 to 19 and even 21 c. c. of decinormal alkali per 50 c. c.

Vaudin[2] has given much study to this question of the reaction of milk. He finds all milk acid to phenolphthalein and that the acidity in the case of the same animal varies within narrow limits under the influence of the food. All factors which disturb milk secretion, as pregnancy, food, etc., affect the acidity. The acidity increases slightly as lactation advances and the time for calving approaches. The milk of rapidly maturing animals, as the cow, goat, and sheep, is more acid than human milk and that of slow-growing animals, as the mare and ass. The author affirms that the acidity is due largely to the acid properties of the proteids and bears a close relation to the amount of salts in the milk, especially calcium phosphate. The variations in acidity which occur during the period of lactation depend upon simultaneous changes in the nature and relative proportions of the various protein substances and the mineral elements of the milk.

Studies on casein.—G. Courant[3] has shown that casein forms three compounds with calcium or sodium—the mono, di, and tri calcic (or sodic) casein. If to a solution of casein in limewater sufficient hydrochloric acid or sulphuric acid be added to combine with all the lime present, the casein will be completely precipitated. If phosphoric acid be used instead the precipitation of the casein occurs first when all the lime has been changed to monocalcic phosphate. Only the dicalcic or disodic casein compounds are curdled by rennet in the presence of water-soluble lime salts, and the completeness of the curdling depends on the amount of lime salts present. The less complete curdling of human milk, as compared with cows' milk, is attributed to the increased alkalinity of the latter.

A. Béchamp,[4] gives the results of an extensive investigation of the

[1] Abs. in Vierteljahr. Chem. Nahr. u. Genussmtl., 7, p. 127, and Chem. Centbl., 1892, II, p. 1024.

[2] Bul. Soc. Chim. Paris, 7-8 (1892), sér. 3, pp. 483-492; abs. in Milch Ztg., 22 (1893), p. 257, Rev. Internat. Falsif., 6 (1893), No. 11, Vierteljahr. Chem. Nahr. u. Genussmtl., 7, p. 127, Chem. Centbl., 1892, II, p. 89, and E. S. R., vol. IV, p. 311.

[3] Arch. ges. Physiol., 50, p. 109; abs. in Ber. deut. chem. Ges., 24, p. 975, and E. S. R., vol. III, p. 744.

[4] Bul. Soc. Chim. Paris, 11, sér. 3, pp. 152-176; abs. in Chem. Centbl., 1894, I, p. 633, and E. S. R., vol. V, p. 1008.

nature and properties of casein. He states that casein is not a soluble substance which may be coagulated by acids, but that it is an insoluble substance forming soluble compounds, caseinates, with alkalies and lime, and that the insoluble casein may be precipitated from these compounds by acids which combine with the bases of the caseinates. He has prepared and studied pure casein. He finds besides the properties already mentioned that it is slightly acid to litmus, slightly soluble in water, forms a gelatinous mass when heated with water, is soluble in dilute hydrochloric acid, and contains phosphorus and sulphur.

J. S. Edkins[1] has followed out Roberts's discovery that milk casein could be so changed by pancreas that it would curdle at a high temperature. The author found that this so-called metacasein reaction was due to a ferment and not to the action of freed organic acids. The metacasein reaction can also be brought about by rennet, using a very small quantity of the extract. The process is studied in detail and the properties of the treated milk described. The author concludes that metacasein is an end product and not an intermediary one.

The passage of solutions of casein through porcelain has been studied by L. Hugounenq.[2]

Digestibility of milk.—The question as to the relative digestibility of raw and cooked, or sterilized, milk has been the subject of a number of investigations. Raudnitz[3] found in experiments with dogs that cooked milk was slightly less digestible than uncooked milk. A. Stutzer[4] studied the matter by means of artificial digestive fluids. His results agree with those of Raudnitz, showing uncooked milk to be somewhat more rapidly digested by the fluids than sterilized milk. This is in agreement with the experiments of Fleischmann and A. Morgen,[5] who found that after cooking or heating the milk the proteids were some what more difficult to digest.

Digestion experiments on healthy young persons between 18 and 23 years of age were made by Wasileff-Petersburg.[6] The proteids of the raw milk were found to be more completely digested than those of the cooked milk. The result was even more pronounced in the case of the fat; the excreta after drinking cooked milk contained a much larger amount of volatile fatty acids than after drinking raw milk. By cooking nearly the whole of the albumen and a part of the casein were changed to hemialbuminose. A similar observation as to the change of proteids by cooking has been made by D. H. Wehberg.

Ellenberger and Hofmeister[7] state that the nature of the casein of

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[1] Centbl. Physiol., 6, pp. 102–107; abs. in Chem. Centbl., 1892, II, p. 95.

[2] Ann. Chim. et Phys., 28 (1893), sér. 6, pp. 528–537.

[3] Ztschr. physiol. Chem., 14, p. 114.

[4] Landw. Vers. Stat., 40, pp. 317–319; abs. in E. S. R., vol. IV, p. 92.

[5] Lehrbuch der Milchwirthschaft, W. Fleischmann, p. 255.

[6] Molk. Ztg., 7 (1892), No. 7; abs. in Vierteljahr. Chem. Nahr. u. Genussmtl., 1892, p. 9.

[7] Molk. Ztg., 7 (1892), No. 6; abs. in Vierteljahr. Chem. Nahr. u. Genussmtl., 7, p. 9, and E. S. R., vol. IV, p. 311.

milk is much changed by sterilizing. It is precipitated in a fine floccular condition, and remains in the stomach in a more or less liquid condition and may pass too rapidly through the stomach and intestines, so that there is danger that it will not be completely digested. They do not regard the question of the digestibility of raw and sterilized milk as settled.

On the other hand, Chavane[1] and Drouet[2] find sterilized or boiled milk more easily digestible than raw milk, experiments to the contrary notwithstanding. Drouet states that the albumen, which is in excess in cows' milk, is coagulated by boiling and separates as a skin on the surface of the milk and can easily be removed. He thinks the taste plays no part when the milk is for infants. He claims to have found from many experiments that infants thrive fully as well and often better on boiled milk than on raw milk. Fayel[3] questions the advisability of giving scalded milk to children, as he claims that it is injurious to health and is not germ free.

In an article on sterilized milk by Leeds and Davis[4] it is recommended to make the milk weakly alkaline with limewater and then heat to 68° or 69° C.; or better, to treat it with pancreatin at 36° and then raise the temperature to boiling. In this way a germ-free and easily digestible milk is said to be obtained.

The fate of the phosphorus in the digestion of casein has been studied by E. Salkowski.[5] He finds, contrary to the usual belief, that in the peptic digestion of casein the whole of the phosphorus goes over into the insoluble paranuclein which is left behind (voided); in fact, only about 1.5 per cent passes into the paranuclein, while the greater part finds its way into the digestive solution. The phosphorus in the latter was in the form of organic compounds. Ortho and meta phosphoric acid were not found.

A. E. Wright[6] proposes to render milk more digestible for infants and invalids by removing part of the lime. Bunge found that cows' milk contained six times as much lime as human milk. Others have found that a lime-free milk did not curdle with rennet, and that the more lime in the milk the harder and tougher was the curd formed with rennet. The author suggests removing part of the lime with sodium citrate, and states that if one part of sodium citrate is added to 200 parts of milk the milk will not curdle with rennet and no taste will be noticeable. If it is desired simply to make the milk curdle like human milk, milk sugar may be added.

Closely related to the above studies is a paper by Soxhlet[7] on the

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[1] Du lait stérilisé, Paris, 1892; abs. in Chem. Ztg., 17 (1893), p. 1550.

[2] Rev. Internat. Falsif., 6; abs. in Ztschr. Fleisch- und Milchhyg., 4 (1894), p. 95.

[3] Rev. Internat. Falsif., 6 (1893), pp. 213, 214.

[4] Rev. Internat. Falsif., 5 (1892), pp. 143, 144.

[5] Centbl. med. Wiss., 1893, pp. 385, 386; abs. in Chem. Centbl., 1893, II, p. 222.

[6] Apoth. Ztg., 8, p. 561; abs. in Chem. Centbl., 1894, I, p. 92.

[7] Münchener med. Wochenschr., 1893, No. 4; abs. in Chem. Centbl., 1893, I, pp. 703, 704.

chemical differences between cows' milk and human milk, and the means of making the two alike. He states that cows' milk and human milk differ with respect to the curdling of the casein, the content of salts, the absolute content of nutrients, and the relation of the various constituents. The nature of the coagulated casein in the stomach depends upon the concentration of the casein solution, the content of soluble calcium salts, and the acidity of the solution. Cows' milk is in these three respects unfavorable to the best coagulation, for it contains twice as much casein, six times as much lime, and is three times as acid as human milk. Human milk contains acid phosphates, but only one third as much as cows' milk. When cows' milk is diluted with water it coagulates nearly like human milk. The excessive acidity can be corrected by adding bicarbonate of soda after the milk is sterilized, but the lime salts can not be diminished. Boiled milk curdles in very fine flocks but requires much rennet; the higher the temperature the greater the extent to which this is true. Through heating, cows' milk is not rendered more digestible, for the heating changes some of the lime salts which are necessary for the curdling to an insoluble form. This is often corrected by adding a little soluble lime to the milk. By diluting cows' milk with one half part of 6 per cent milk sugar solution, a mixture is produced with about as much protein and milk sugar as human milk, but with 1.32 per cent less fat. To make up for this deficiency milk sugar is added—one half part of 12.3 per cent milk sugar solution. Milk sugar is better fitted for this purpose than anything else.

Sheep's, goats', and mules' milk.—Italian sheep's milk has been examined by C. Besana.[1] The specific gravity at 15° C. ranged from 1.037 to 1.043, and averaged 1.0395. The average composition was 21.77 per cent of solids, 9.5 fat, 6.26 proteids, 5 milk sugar, and 1.01 ash. The fat globules were nearly three times as large as those of cows' milk, and the cream rose very slowly. The creaming was improved when the milk was diluted with water. Sheep's milk soured spontaneously more slowly than cows' milk, and required more rennet to curdle it; that is, with an equal quantity of rennet a longer time was required for the sheep's milk. In another paper[2] the author discusses the composition of the butter and cheese made from sheep's milk.

The detection of goats' milk in cows' milk is discussed by Schaffer.[3]

J. H. Shepperd[4] determined the yield and composition of the milk of four ewes which had recently lambed, milking each for a number of days. The average daily yield varied from 2.51 to 3.96 pounds, indicating "that much might be accomplished in growing lambs by carefully selecting good milkers for breeding." The specific gravity of the milk

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[1] Chem. Ztg., 1892, p. 1519; abs. in E. S. R., vol. IV, p. 514.

[2] Staz. Sper. Agr. Ital., 23, pp. 572-630; abs. in Chem. Centbl., 1893, I, p. 631.

[3] Schweiz. Wochenschr. Chem. u. Pharm., 31 (1893), p. 58; abs. in Chem. Ztg., 17 (1893), and Repert., p. 67.

[4] Agl. Science, 6 (1892), pp. 397-405.

ranged from 1.034 to 1.043. The fat content was usually between 5 and 7 per cent, but varied widely, as the animals were evidently much disturbed by being milked. It averaged for all the ewes 5.6 per cent. The ewes produced less milk and less solids for the food consumed than cows.

Milk sheep dairying is discussed in *Molkerei Zeitung*,[1] the profits from keeping sheep for dairy purposes, extent to which it is practiced, and the properties of sheep's milk being given.

The composition and properties of mules' milk have been determined by A. B. Aubert and D. W. Colby.[2] They find that the milk is acid, and after standing a week, sours without curdling. The average composition found was, solids 10.86 per cent, fat 1.98, proteids 2.31, sugar 6.4, and ash 0.53, thus resembling mares' and asses' milk.

Colostrum.—Extensive studies on colostrum have been made by Krüger.[3] He gives the range of composition observed, which was as follows: Total solids 21.68 to 28.48 per cent, fat 3.27 to 4.96, solids-not-fat 17.96 to 24.47, casein 5.52 to 8.92, albumen 9.32 to 12.51, ash 0.88 to 1.21, and milk sugar 0.52 to 1.99. Cholesterin, lecithin, leucin, tyrosin, urea, lutein, and animal gum were recognized with certainty. The ether extract contained 12.9 per cent of cholesterin and 8.1 of lecithin. The volatile fatty acids were lower than in butter fat. These increased during the first few days until the amount became normal. Analysis of the ash constituents showed the soda and potash to be lower than in normal milk.

J. L. Hills[4] reports results of work on the composition, creaming, and churning of colostrum. The average composition of colostrum of three cows from the first four milkings after calving are given. The points of interest were "the higher specific gravity, the larger per cent of total solids, ash, and nitrogenous bodies, and the smaller per cent of milk sugar in the colostrum than in the milk, and the rapidity with which the fluid becomes more like milk." Colostrum creamed readily and quite completely in deep-setting. The cream was churned, more time being required than for churning normal cream. Colostrum butter was vividly yellow, and retained the strong odor of colostrum in spite of thorough washing. It had the acrid, disagreeable colostrum taste and became rancid much more rapidly than normal butter. In composition it differed very little from normal butter.

Miscellaneous studies on milk.—The action of heat on milk, as observed by H. D. Richmond and L. K. Boseley,[5] was to reduce the specific rotation of the milk sugar. An attempt to discover a constant factor

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[1] Molk. Ztg., 6 (1892), Nos. 43 and 44.

[2] Jour. An. and App. Chem., 7, pp. 314–316.

[3] Molk. Ztg., 6 (1892); abs. in Chem. Centbl., 1892, II, p. 1023, and Vierteljahr. Chem. Nahr. u. Genussmtl., 7, p. 126.

[4] Vt. Sta. Report for 1891, pp. 104–108; abs. in E. S. R., vol. IV, p. 487.

[5] Analyst, 1892, pp. 222–225, and 1893, pp. 141, 142; abs. in E. S. R., vol. IV, p. 978.

for this change for a unit of time was unsuccessful, samples heated for the same time showing wide variations. The reducing power of Fehling's solution was not materially changed by heating.

H. D. Richmond[1] finds that rennet, pepsin, and pancreas extract are without action on milk sugar, and that consequently the milk sugar in whey and artificially digested milk can be accurately estimated, provided they have not been heated.

M. Arthurs[2] points out the correspondence between the coagulation of blood and the curdling of milk with rennet. The points of similarity are in the physical properties of the coagulated mass; the effect of temperature, calcium salts, etc.; the serum; and the products of decomposition. They differ in that fibrin can be beaten to a stringy mass, while casein can not; in the coagulation of fibrin, calcium can be replaced only by strontium, while in the curdling of milk with rennet barium, strontium, or magnesium may take its place; and fibrinogen breaks up into two globulines, while casein breaks up into caseum and proteose.

Concerning the relation of milk and its constituents to putrefaction, H. Winternitz[3] finds that milk is unfavorable to putrefaction and hinders the decomposition of the albuminoids. As the fat was found to be without effect on putrefaction, he believes this unfavorable effect to be due to the milk sugar through its breaking up into acid. Milk likewise influences putrefaction in the intestines and prevents the decomposition of albuminoids to products useless or injurious to the body.

As to the acidity of sour milk, Jules and Stokes[4] found that milk which was sour to the taste had between 0.4 and 0.49 per cent of acid. Milk was found with 0.5 per cent of acid which was otherwise good and remained in this condition for seventy-one hours.

The immunity from cholera secured through the milk of inoculated goats has been investigated by Ketscher and Gamaleia.[5] Five cubic centimeters of milk from goats inoculated with a virulent culture of cholera germs was sufficient to render a guinea pig immune to otherwise fatal doses of the cholera culture; control animals died in six to ten hours after inoculation. Milk of uninoculated goats did not possess the property of rendering animals immune. Again, guinea pigs inoculated with deadly doses of cholera and then treated with intraperitoneal applications of the goats' milk did not die, while control animals died. They conclude that the milk of inoculated goats not only renders animals immune, but also has healing properties toward the disease in question.

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[1] Analyst, 1892, p. 222; abs. in E. S. R., vol. IV, p. 584.

[2] Compt. Rend., 117, p. 435; abs. in Centbl. Physiol., 7, p. 702, and Chem. Centbl., 1894, I, p. 592.

[3] Ztschr. physiol. Chem., 16, pp. 460–487.

[4] Rev. Internat. Falsif., 6; abs. in Ztschr. Fleisch- und Milchhyg., 4 (1894), p. 96.

[5] Abs. in Chem. Centbl., 1893, II, p. 608, and Vierteljahr. Chem. Nahr. u. Genussmtl., 8 (1893), p. 8.

Brieger and Ehrlich[1] studied the milk of goats inoculated with a culture producing tetanus to determine the nature of the substance causing immunity. The milk contained foreign bodies forty one days after inoculation. A substance was isolated from the milk which was found to be from 400 to 600 times as powerful in its action as the milk itself. Whey was as powerful as the whole milk. The substance was found in the blood of the animals, but not in as large quantity as in the milk, due perhaps to the method employed for its separation. Further contributions on this subject, relating especially to the isolation of the substance, have been given by L. Brieger and G. Cohn.[2]

SECRETION OF MILK.

Concerning the activity of the physiological process by which milk is secreted, P. Collier[3] found from observations on a large number of cows that on an average the cows secreted 0.7 pound each or nearly 19.6 cubic inches of milk per hour, and that there were 152 fat globules per 0.0001 mm. of milk. He concludes that this is equal to an average secretion of 136,000,000 fat globules per second. Again, the same author[4] found from observations on 23 cows that there was an average secretion of 138,210,000 fat globules per second.

H. Kaull[5] found from investigations of the milk from fractional milkings that (1) the secretion of any single ingredient, as fat, is not affected by the act of milking; (2) no considerable formation of milk takes place during milking; (3) too frequent milking, and allowing the milk to remain in the glands too long, both tend to diminish the secretive activity of the glands; and (4) frequent milking within certain limits may result in an increased production of milk, not through the act of milking itself, but through the stimulus arising from the emptying of the glands.

As to the regularity of milk secretion, P. Collier[6] reports that, milking regularly at 5 a. m. and 5 p. m., there was secreted per hour, on an average for five different breeds, 0.696 pound of milk during the night and 0.7 pound during the day. The average morning's milk was very slightly richer in every ingredient than the average evening's milk.

From tests made by fractional milking, P. Collier[7] shows that there is an increase in the number and size of fat globules and in the percentage of fat in the milk from the beginning to the end of milking. The half milked first contained only one third to one half as much fat

[1] Ztschr. Hyg., 13, pp. 336–346; abs. in Chem. Centbl., 1893, I, p. 620.

[2] Ztschr. Hyg., 15, p. 439; abs. in Chem. Ztg., 18 (1894), Repert., p. 21, Milch Ztg., 23 (1893), p. 85, and Chem. Centbl., 1894, I, p. 596.

[3] N. Y. State Sta. Report for 1891, p. 155; abs. in E. S. R., vol. IV, p. 258.

[4] N. Y. State Sta. Report for 1892, p. 162.

[5] Ber. landw. Inst., Halle, No. 8, pp. 1–20; abs. in E. S. R., vol. IV, p. 442.

[6] N. Y. State Sta. Report for 1891, p. 121; abs. in E. S. R., vol. IV, p. 257.

[7] N. Y. State Sta. Report for 1891, p. 129; abs. in E. S. R., vol. IV, p. 257.

as the last half. The difference between successive portions milked appeared to be confined almost wholly to the fat. He suggests that as the secretion has been found to be a regular and continuous process the difference in fat shown by fractional milkings may be due "merely to what, by comparison, we may term warm-setting within the udder and other milk vessels of the animal."

Y. Melander[1] found that, dividing the milk into halves, the half milked first contained from 0.55 to 0.9 per cent of fat, and the last half from 6.8 to 10 per cent; dividing it into thirds, the first third contained from 0.45 to 0.75 per cent, and the last third contained from 6.3 to 7 per cent of fat. E. Gutzeit[2] also observed that the size of the fat globules and the percentage of fat increased in milking from the beginning to the end. The fat from different portions of the milking, however, had the same melting point and the same content of volatile fatty acids.

While as a rule the last portions of the milking have been found richer in fat than the first, H. H. Dean[3] notes some exceptions. In the case of one cow the fourth portion contained only 1.8 per cent more fat than the first, and in the case of another the first sample was richer than the second. Hittcher[4] reviews the data of Fleischmann's[5] observations on 16 cows during one period of lactation. He concludes that the natural qualities of the cow very largely control the milk secretion, and that for this reason generalizations as to milk secretion should be made with care.

A case of milk production without calving is mentioned by Gabbey.[6] A heifer which had never shown signs of heat commenced to enlarge in the udder and, although no calf was born, was soon milked. She had continued to give milk for three years—about 6 liters per day—without calving, and in this time had never gone dry. Finally she was bulled, but failed to get with calf.

A statement[7] has gone the rounds of the agricultural papers that *Morrenia brachystephana*, a plant of the family *Asclepiadaceæ*, growing wild in Argentine Republic, has a strong influence in promoting milk secretion, even when the milking period is at an end. It is used in the form of a tea made from the leaves or dried root, or in the form of cooked fruit.

Milking.—H. H. Dean[8] has compared the yield and composition of

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[1]Nord. Mejeri Tidn., 1892, Nos. 48 and 49; abs. in Milch Ztg., 22 (1893), p. 23, and Chem. Centbl., 1893, I, p. 435.

[2]Milch Ztg., 22 (1893), p. 440.

[3]Ontario Agl. College and Exptl. Farm Report for 1891, p. 185; abs. in E. S. R., vol. V, p. 644.

[4]Milch Ztg., 22 (1893), p. 849.

[5]Landw. Jahrb., 20 (1891), sup. II, p. 368; abs. in E. S. R., vol. III, p. 424.

[6]Pless. Jahresber. preuss. Tierärzte; abs. in Molk. Ztg., 7 (1893), No. 16, p. 211.

[7]Abs. in Milch Ztg., 22 (1893), p. 292; Berl. Tierärztl. Wochenschr., 1893, Mar. 30, and in Vierteljahr. Chem. Nahr. u. Genussmtl., 8, p. 97.

[8]Ontario Agl. College Exptl. Farm Report for 1892, p. 210; abs. in E. S. R., vol. V, p. 643.

the milk of 2 cows for two weeks when the teats on each side were milked together (gland) and when opposite or diagonally opposite teats were milked together (quarter). With one cow there was practically no difference while the other gave less fat, both in per cent and total quantity, on "gland milking." From similar trials F. Albert[1] concludes that "quarter" milking gives an increase in yield of milk and in percentage of fat over milking one side at a time. He feels so sure of his conclusion that he strongly recommends that this method of milking be always followed.

H. H. Dean[2] compared milking two and three times a day, with the result that for a period of two weeks the milk was a little richer in fat from milking three times. He believes that for a short time the cows might be kept under a high pressure by milking three times, but states that they seem to regulate themselves to a normal production in a short time. J. L. Hills[3] compared milking two and three times a day on farrow and fresh cows. Less milk was given when the cows were milked three times a day in three out of four trials, and the quality of the mixed milk of the whole day was always lowered by milking three times a day. V. Uhrmann[4] reports three experiments on this subject, made in July, August, and October, with 2 or 3 cows each, lasting from twenty-five to thirty-one days. Somewhat more milk and butter were obtained in each experiment when the cows were milked three times. From a physiological standpoint the author recommends milking three times, especially in the case of heifers, on account of the benefit from exercising the milk glands. In another paper the same author[5] holds that exercising the glands, as in milking, excites them to greater milk production, and that this is of importance in the case of young undeveloped animals. He recommends that heifers with first calf be milked, although little milk can be secured, and that the calf be allowed to suck at will rather than at stated intervals. He mentions the case of 3 heifers which were milked for a month before first calving. From a few drops of milk they increased to half a pint. The heifers made excellent cows and the best milkers in the herd of 48 of similar breeding.

Recovery of food ingredients in the milk.—As to the relation between the food eaten and the milk constituents secreted, P. Collier[6] has shown that on the average of 15 cows for one period of lactation the casein produced was equivalent to 27.5 per cent of the albuminoids consumed; in a previous trial with 5 cows it was 26.5 per cent. The fat in the food was 17 per cent greater than that in the milk. In the earlier

[1] Milch Ztg. 23 (1894), pp. 231–234.
[2] Ontario Agl. College and Exptl. Farm Report for 1892, pp. 209, 210; abs. in E. S. R., vol. v, p. 642.
[3] Vt. Sta. Report for 1890, pp. 90–92; abs. in E. R. S., vol. III, p. 474.
[4] Molk. Ztg., 7 (1893), p. 450.
[5] Molk. Ztg., 7 (1893), pp. 209, 210.
[6] N. Y. State Sta. Report for 1891, p. 140; abs. in E. S. R., vol. IV, p. 255.

months of lactation the production of fat was considerably in excess of the consumption, but the two soon became equal and in the later months the consumption was in excess of the production. The data presented do not show that a change in the albuminoids or the fat of the food produced any regular change in the fat in the milk. The same author[1] presents a summary of the data for a large number of cows of different breeds for three years, showing that the food contained sufficient fat to account for all that in the milk. The data "give reason for the belief that it is this fat in the food which normally furnishes that found in the milk." He also showed[2] that cows consumed on an average 2,435 pounds of water per month and per cow while in milk and 1,586 pounds while dry, the difference of 849 pounds being partly accounted for by the milk, which averaged 529 pounds per month. While in milk 31.8 per cent of the water was consumed in the food and 68.2 as drink, and while dry the proportion was 34.5 and 65.5 per cent, respectively. On an average for the entire herd for three years, 4.6 pounds of water was consumed for each pound of milk produced. H. Snyder[3] found that the yield of solid matter in the milk was equal to 8.58 per cent of that in the food in the case of one cow and 9.85 per cent in the case of another.

From a review of a considerable amount of data, original and otherwise, C. E. Thorne, J. F. Hickman, and F. J. Falkenbach[4] show that on a ration of one fourth to one fifth grain and the rest coarse fodder there was produced, on an average, about 3.2 pounds of butter fat for each 100 pounds of dry matter eaten, besides a small gain in weight. "In general, when this rate of production has been exceeded, there has been a loss in live weight, and when the butter fat has fallen below this weight there has been a gain in live weight." The same authors[5] found by summarizing the results of a large number of American experiments in feeding steers that on an average "the increase in live weight per 100 pounds of dry matter fed to steers has been about three times as great as the production of butter fat from the same quantity and kind of feed fed to cows." This ratio applied to young cows increasing in live weight showed "almost exact compensation between the fluctuations in butter-fat production and live-weight increase," but this was not quite true in the case of older animals. The ratio is a tentative one and is affected by age, period of lactation, breed, and other factors.

EFFECT OF VARIOUS FACTORS ON MILK PRODUCTION.

Effect of food on milk.—The question of the effect of food upon the yield and composition of milk is one which has called forth a variety of

[1] N. Y. State Sta. Report for 1892, p. 146.
[2] N. Y. State Sta. Report for 1892, p. 143.
[3] Minn. Sta. Bul. No. 26; abs. in E. S. R., vol. IV, p. 733.
[4] Ohio Sta. Bul. No. 50; abs. in E. S. R., vol. V, p. 887.
[5] Ibid.

opinion and much experimental work in the past, and is at present regarded by many as unsettled. It is held by many that after a certain point is passed food is of only secondary importance, and that much more depends upon the qualities of the animal itself and the natural capability of the glands for secreting milk. As between a deficient and a complete ration the latter will prove the most favorable to the production of milk and butter in the long run, as the cow must naturally be furnished with materials for manufacturing milk. The point at issue is whether by the addition of nutrients to an already normal ration the percentage of solids in the milk or the percentage of one or more of the constituents of the solids can be increased. An increase in the percentage or absolute amount of a single ingredient without a change in the other solids has only been noticed in a few isolated cases.

A number of résumés of recent investigations upon the effect of food on milk have been published.[1]

Collier[2] found that at a time when a herd of cows was nearly dry the substitution of cotton-seed meal for corn meal, thus increasing the albuminoids in the food 7.6 per cent and the fat 8.4 per cent, served to keep up the yield of milk at a time when it might be expected to be falling off, and resulted in an absolute increase in the fat produced in all but two cases. C. Schneider[3] found that with the exception of pasturage, which showed a slight effect on the milk, other foods, as grass, clover, corn, beet leaves, and beets, and the manner of feeding had much less influence on the composition of the milk than the period of lactation.

Juretschke[4] studied the effect on the milk of adding cocoanut cake, peanut cake, and rape cake to the basal ration in three separate periods of twenty days each. The results failed to show conclusively any transmission of fat from the food to the milk, but were not concordant. The rations were in excess of Wolff's standard. The conclusions arrived at are that the milk secretion is not directly, but only indirectly, affected by feeding and that the feeding of large amounts of fat does not increase the yield of butter fat. Backhaus[5] found that feeding peanut cake, palm cake, and cotton-seed cake separately in amounts of from 2 to 3.5 pounds per day in addition to a basal ration showed no difference in the effect on the yield and composition of milk.

When brewers' grains and peanut cake were added to a basal ration in varying proportions, Kochs and Ramm[6] observed that in the case of

[1] Handbook of Expt. Sta. Work, p. 209; Milch Ztg., 23 (1894), pp. 117–119; and Deut. Vierteljahr. öff. Gesund., 25, pp. 235–263; abs. in Molk. Ztg., 7 (1893), pp. 197, 198.

[2] N. Y. State Sta. Report for 1891, p. 140; abs. in E. S. R., vol. IV, p. 255.

[3] Inaugural Dissertation, Leipsic; abs. in Deut. Molk. Ztg., 1893, No. 23, and in Chem. Centbl., 1894, I, p. 563.

[4] Inaugural Dissertation, Leipsic; abs. in Molk. Ztg., 7 (1893), pp. 518, 519.

[5] Jour. Landw., 41, pp. 328–332; abs. in E. S. R., vol. V, p. 917.

[6] Landw. Jahrb., 21, p. 809; abs. in E. S. R., vol. IV, p. 599.

every cow the absolute yield of milk and fat increased with the increased consumption of protein, this increase being greatest with the change from a ration of 1:8.19 to 1:5.42. When changed from a wide to a narrow ration the cows shrunk in yield of milk and fat. There was no change in the percentage of fat which could be attributed to the change in the food. The results show that it is possible by rich feeding to maintain the yield of milk and of fat well up to the end of the period of lactation, and it is believed that this is more easily done when the heavy feeding is begun early in the period.

W. P. Brooks[1] reports that on soja-bean meal somewhat more milk was obtained, less but richer cream, and butter of better quality than on cotton-seed meal. On cotton-seed meal the butter was harder, but had a greasy texture. On soja-bean meal it had a richer color. E. H. Farrington[2] reports that a gradual increase of the grain feed, consisting of corn-and-cob meal, wheat bran and linseed meal, or linseed meal alone, from 12 to 24 pounds per head daily, and a change from barn to pasture feed, each increased the yield of milk, but had very little if any effect on its quality. A. H. Wood[3] tested the effects of various rations. The casein did not appear to be affected by a change from food poor in protein to that rich in protein. Clover hay appeared to keep up the milk yield.

In two separate comparisons of corn silage (30 pounds) with field beets (50 pounds) C. E. Thorne, J. F. Hickman, and F. J. Falkenbach[4] found that the cows consumed more dry matter and produced more milk and butter fat while on the beet rations, but the fat content of the milk was not materially affected by the food. It is believed that beets increased the yield of milk. The yield of milk in proportion to the dry matter eaten was about 6 per cent greater on the silage ration than on the beets. The beets cost more, however, and were not profitably fed.

Rations containing varying proportions of barley and oats, and of a mixture of palm-nut meal, rape-seed cake, and sunflower-seed cake, were compared in coöperative experiments in Denmark.[5] There was no change in the chemical composition of the milk on the different rations, although the quantity of milk increased with the heavier oil-cake feeding. Von Liebenberg[6] noticed that the addition of 2 pounds of rape cake per day to the ration of oats and corn silage increased the yield of milk to a profitable degree, but the composition of the milk is not stated.

An experiment in feeding milk to cows is reported by J. Wilson and

[1]Mass. Agl. College Catalogue for 1893, p. 30.

[2]Ill. Sta. Bul. No. 24; abs. in E. S. R., vol. IV, p. 940.

[3]N. H. Sta. Bul. No. 18; abs. in E. S. R., vol. V, p. 688.

[4]Ohio Sta. Bul. No. 50; abs. in E. S. R., vol. V, p. 887.

[5]Syv. og. tyvende Beretning fra den Kgl. Vet. Landbohöjsk. Lab. Landökon. Forsög., Copenhagen, 1892, pp. 165; abs. in E. S. R., vol. IV, p. 601.

[6]Mitt. Ver. Förd. landw. Versuchsw. in Oesterr., 1893, No. 8, part II, pp. 155–162.

G. E. Patrick.[1] Whole milk and skim milk fed to two Holstein cows at pasture seemed to keep up the yield and quality of milk at a time when pastures were drying up and when shrinkage was general in all cows on pasturage alone. As soon as the milk or skim milk was discontinued the cows shrunk in yield of milk and in quantity of solids and fat.

P. Gay[2] concludes that richer and more concentrated food will increase the quality of milk, but that the individuality of the cow has more influence on the richness of the milk. O. Och[3] states that like quantities of dried brewer's grains and dried distillery slop had about the same effect on the yield and quality of milk, but that the cows were rather better nourished on the dried distillery slop. In an experiment reported by H. H. Dean[4] mixing the grain to a thick slop with water was not followed by a thinner milk, but the cows shrunk in milk yield more rapidly than when the grain was fed dry. Backhaus[5] found that when cows were kept in stalls with water before them constantly they averaged 0.53 liter of milk more per cow daily than when watered twice daily, and there was no decrease in the fat content.

W. W. Cooke and J. L. Hills[6] noted the effect on a herd of cows of changing from barn feed to pasturage, *i. e.*, "a gain of about one fourth more butter per day per cow;" and L. L. Van Slyke[7] observed that about the time the cows were turned to pasture there was an increase both in yield of milk and in percentage of total solids, but when the pastures dried up in July and August and grasshoppers were doing much damage there was a decrease in yield of milk and in percentage of solids in the milk. "Fat was much less affected by the dry pastures than the solids-not-fat."

Observations on the effect of various coarse fodders have also been published by C. S. Phelps,[8] W. W. Cooke and J. L. Hills,[9] H. H. Dean,[10] and W. J. Quick.[11] The effect of grain for cows at pasture has been observed by I. P. Roberts[12] and H. H. Dean.[13]

According to Montefusco[14] corn gives a perfectly white milk, while the feeding of *Mercurialis perennis*, *Fagopyrum*, *Polygonum*, and some

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[1] Iowa Sta. Bul. No. 17; abs. in E. S. R., vol. IV, p. 181.

[2] Anal. Agron., 19 (1893), 6, pp. 293–302.

[3] Inaugural Dissertation, Liepsic, 1893, pp. 67; abs. in Chem. Centbl., 1894, I, p. 562.

[4] Ontario Agl. College and Exptl. Farm Report for 1893, p. 150.

[5] Milch Ztg., 22 (1893), p. 40; abs. in E. S. R., vol. IV, p. 773.

[6] Vt. Sta. Report for 1891, p. 69; abs. in E. S. R., vol. IV, p. 491.

[7] N. Y. State Sta. Bul. No. 65, n. ser.; abs. in E. S. R., vol. V, p. 89.

[8] Conn. Storrs Sta. Bul. No. 59; abs. in E. S. R., vol. IV, p. 480.

[9] Vt. Sta. Report for 1891, p. 75; abs. in E. S. R., vol. IV, p. 481.

[10] Ontario Agl College Bul. No. 80; abs. in E. S. R., vol. IV, p. 606.

[11] Colo. Sta. Bul. No. 20; abs. in E. S. R., vol. IV, p. 259.

[12] N. Y. Cornell Sta. Buls. Nos. 36 and 49; abs. in E. S. R., vols. III, p. 613, and IV, p. 842.

[13] Ontario Agl. College and Exptl. Farm Report for 1893, p. 148.

[14] Abs. in Ztschr. Fleisch- und Milchyg., 4 (1894), p. 74.

other plants common in the Italian meadows imparts a bluish color to the milk. *Euphorbia* spp., which are eagerly eaten by goats, give rise to a diastatic action of the milk.

Vandenhoydonck[1] reports a case in which the milk of all the cows of a village became bitter, although they were all found to be healthy. After this had continued for six months, the cause was located in the feeding of Swedish turnips, which had been washed in foul ditch water. As soon as these were discontinued the milk became all right. Weigmann and Zürn[2] report a case in which the straw used for bedding caused soapy milk. N. Auerbach[3] calls attention to the effect of food on the keeping qualities of the milk, and elsewhere[4] the influence of odors on the quality of milk is mentioned.

The effect on the ash of milk of adding phosphate of lime to the food has been studied by E. Hess and Schaffer[5] and J. Neumann.[6] It is claimed in both experiments that the feeding was accompanied by an increase in the percentage of phosphoric acid in the ash. Hess and Schaffer mention that in a disease known as "galt" the phosphoric acid content of the milk is abnormally low; it was found possible to bring this up to the normal by feeding phosphate of lime. Neumann states that the increase in phosphate is not apparent until the feeding has been continued for three or four weeks. He believes that the production of milk with a specially high phosphate content, so-called "phosphate milk," by feeding is impossible.

According to E. Hess, J. Schaffer, and M. Lang,[7] Glauber's salts are often fed in some parts of Switzerland, being cheaper than common salt. They fed 4 cows amounts increasing from 40 to 60 grams per head daily, and compared the results with common salt. The cows gave signs of disease of the udder, as bloody milk, caking, catarrh, and mammitis. After a fortnight the milk was normal in appearance, but had a peculiar salty taste, similarto a weak solution of Glauber's salts. The most striking change in the milk was a decrease in the ability of the casein to curdle with rennet. Within six days after beginning to feed Glauber's salts, while the cows were suffering from disease of the udder, the milk was rich in fat, and especially during udder catarrh the milk was richer in chlorides and poorer in phosphates.

The effect of feeding potassium chlorate, according to Bieler,[8] was an increase in yield of milk at the expense of the quality. Corne-

[1] Schweiz. Arch., 35; abs. in Molk. Ztg., 7 (1893), p. 693.

[2] Milch Ztg., 22 (1893), p. 569; abs. in E. S. R., vol. v, p. 431.

[3] Milch Ztg., 22 (1893), pp. 490, 491, 506, 508; abs. in Agl. Science, 1894, Jan., p. 35.

[4] Rev. Internat. Falsif., 6 (1893), p. 199.

[5] Landw. Jahrb. Schweiz., 5, p. 76; abs. in Chem. Ztg., 16 (1892), Repert., p 15, and E. S. R., vol. III, p. 744.

[6] Milch Ztg. 22 (1893), pp. 701–704; abs. in E. S. R., vol. v, p. 639.

[7] Landw. Jahrb. Schweiz., 7, (1893), pp. 210–229; abs. in E. S. R., vol. v, p. 918.

[8] Abs. in Milch Ztg., 17 (1893), p. 1338.

vin[1] found that philocarpin, which increases the sugar in the blood, increased the sugar in the milk from about 0.65–1 gram per liter to 4.6–5.5 grams. It did not increase the sugar in the urine. Phloridzin, which is known to increase the sugar in the urine without increasing that in the blood, also doubled the sugar in the milk.

Effect of weather, treatment, and breeding.—W. W. Cooke and J. L. Hills[2] observed that in the spring there was a general tendency of the milk to become richer when the temperature was falling and poorer during a rising temperature. The quantity was affected in reverse order, decreasing in cold spells. Storms did not diminish the yield or quality. C. L. Ingersoll and H. B. Duncanson[3] found that when the cows were warmly stabled there was apparently no constant change due to sudden storms or changes of the weather. The changes in food were accompanied by little actual change in the amount of fat, any change in percentage being compensated for by a change in yield of milk.

Changing the quarters of a herd of cows and driving them 3½ miles, J. L. Hills[4] found to temporarily increase the yield of milk, and, as a rule, to decrease the quality. In two series of experiments Backhaus[5] believed that he observed a slight increase in the yield of milk and in the percentage of fat when cows were cleaned off and well cared for. The effect of shelter on cows during winter was observed by C. S. Plumb.[6] The cows kept out of doors in severe weather ate more food and gave less milk than those kept indoors; they likewise lost flesh, while those sheltered gained in weight. From a financial point of view a considerable gain is figured out from sheltering the animals.

As to the effect of breeding on the quality of the milk W. W. Cooke[7] reports a number of trials which showed little if any improvement from breeding cows already giving rich milk; with poor cows an improvement was apparent. "In a herd already giving a good quality of milk the farmer is confined to selection as his method of increasing the richness of the milk, breeding being used to preserve what has been gained by care, feed, and selection."

Transmission of substances to the milk.—Fröhner[8] has studied the transmission to the milk of various substances consumed by the animal, A number of coloring matters were traced in the milk, the odor of onion.

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[1] Compt. Rend., 116 (1893), p. 263; abs. in Chem. Ztg., 17 (1893), Repert., p. 55, and Milch Ztg., 22 (1893), p. 256.

[2] Vt. Sta. Report for 1891, p. 65; abs. in E. S. R., vol. IV, p. 491.

[3] Nebr. Sta. Bul. No. 30; abs. in E. S. R., vol. V, p. 598.

[4] Vt. Sta. Report for 1891, pp. 87, 88; abs. in E. S. R., vol. IV, p. 483.

[5] Jour. Landw., 41, pp. 332–342.

[6] Ind. Sta. Bul. No. 47; abs. in E. S. R., vol. V, p. 598.

[7] Agl. Science, 7 (1893), pp. 297–299.

[8] Ztschr. Fleisch- und Milchhyg. 1, No. 10; abs. in Chem. Centbl., 1892, I, p. 231, and Centbl. Agr. Chem., 21, p. 782.

garlic, and leek, and the taste of corn, cabbage, and fish. There were also transmitted to the milk, sometimes in poisonous quantities, camphor turpentine, camomile, aloe, arsenic, lead, and tartar emetic. A number of bitter stuffs were not transmitted. The milk from a goat fed *Euphorbia* spp. and that of a cow fed decayed beet tops and ricinus cake was injurious to health. Milk to which aloe, mercury, and copper had been transmitted was also injurious. He concludes that, unlike, meat, milk may be injured by giving medicines to cows. Baum[1] reports that the milk of a goat and a sheep which for eight days had received doses of from 1 to 5 grams of tartar emetic until they appeared to be poisoned was consumed by a man and by dogs without the slightest ill effects. He concludes that the tartar emetic was not transmitted to the milk. As to the danger of consuming the milk of sick cows, F. Baum[2] concludes, from experiments of his own and an extensive review of the literature, that the use of raw milk of cows suffering from tuberculosis, mouth-and-foot disease, and anthrax is attended with absolute danger; and that the milk of cows suffering from lung diseases or diseases of the alimentary canal and udder, or fevers, and of cows which have been treated with poisons, especially arsenic, opper, iodine, mercury, tartar emetic, carbolic acid, morphine, belladonna, strychnine, etc., is more or less dangerous and should not be used as food. Among the plants mentioned to be excluded from the food are *Colchicum autumnale*, *Hyoscyamus* spp., *Datura stramonium*, *Papaver somniferum*, *Sinapis*, *Euphorbia* spp., *Ranunculaceæ*, etc.

Klingemann[3] has made experiments on the transmission of alcohol from the food to the milk. Following doses of 100 to 200 c. c. of alcohol to goats small quantities of alcohol was found in the milk, which disappeared after the second or third milking. No alcohol was found in human milk except after the consumption of considerable quantities.

The transmission of nitrates to milk was observed by H. D. Richmond.[4] When cows were given doses of 1 gram of potassium nitrate per day for three days the milk gave a reaction for nitrates twenty hours after the last dose had been given.

EFFECT OF FOOD ON BUTTER.

A review of recent investigations upon the influence of food upon the qualities of butter fat has been given by W. Frear.[5] Adolf Mayer[6] noticed that when cows were fed 4.4 pounds of cane sugar per animal

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[1] Monat. prakt. Tierheilkunde, 3, No. 9; abs. in Chem. Centbl., 1893, I, p. 162.

[2] Arch. wissensch. u. prakt. Tierheilkunde, 18, No. 3 and 4; abs. in Deut. landw. Presse, 1893, pp. 296, 308, 344, 352, 356.

[3] Molk. Ztg. 6 (1892), p. 5; abs. in Vierteljahr. Chem. Nahr. u. Genussmtl. 7, p. 7, and E. S. R., vol. IV, p. 311.

[4] Analyst, 1893, p. 279; abs. in E. S. R., vol. V, p. 644.

[5] Agl. Science, 7 (1893), pp. 120-141.

[6] Milch Ztg., 21 (1892), pp. 45-50; abs. in E. S. R., vol. III, p. 744.

daily the melting point and point of solidification of the fat both decreased and the volatile fatty acids increased. Continuing this study, the same author[1] found that concentrated lactic acid (50 c. c.) and volatile fatty acids from a stearin factory (100 c. c.) showed no effect on the volatile fatty acids of the butter. He gives a list of coarse and concentrated foods arranged in the order in which they increased the volatile fatty acids. His results afford considerable support to the hypothesis that rations rich in carbohydrates have a favorable effect in increasing the volatile fatty acids. He traces no connection between the fat in the food and that in the butter. The melting point and point of crystallization decreased as lactation advanced. The effect of the feeding stuffs on hardness was the reverse of the effect on the volatile fatty acids.

F. W. Morse[2] found that corn meal had no effect on the volatile fatty acids, but gave a harder butter; gluten meal raised the iodine number; cotton-seed meal lowered the volatile acids and the iodine number; and clover hay appeared to increase the volatile acids. Olein increased the volatile fatty acids, while cotton-seed oil, palm oil, corn oil, cocoanut oil, and stearin caused the volatile acids and iodine number to vary according to their own content of volatile fatty acids and their iodine numbers, the volatile acids fed decreasing those of the butter and the high iodine number increasing that of the butter. The results of these trials "do not agree with the theory that milk fat is formed from the albuminoids only of the food constituents and that fats in the food do not enter into the fat of the milk. Of the constituents of corn meal, the gluten or albuminoids had the property of affecting the volatile acids in the butter, while the starch and oil affected the iodine number, the former decreasing and the latter increasing it." In agreement with the above, A. H. Wood[3] affirms that butter produced on corn meal was decidedly harder than that produced on gluten meal and cotton-seed meal.

J. Wilson, D. B. Bisbee, and F. A. Leighton[4] observed that sugar beets produced a better butter than potatoes, although "the higher grades of butter can not be made from heavy feeding of either raw sugar beets or raw potatoes." E. R. Lloyd[5] states that butter produced on steamed cotton seed was superior to that produced on either raw cotton seed or on cotton-seed meal.

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[1] Landw. Vers. Stat., 41 pp. 14–35; abs. in E. S. R., vol. IV, p. 509.
[2] N. H. Sta. Bul. No. 16; abs. in E. S. R., vol. IV, p. 662.
[3] N. H. Sta. Bul. No. 18; abs. in E. S. R., vol. V, p. 688.
[4] Iowa Sta. Bul. No. 17; abs. in E. S. R., vol. IV, p. 181.
[5] Miss. Sta. Bul. No. 21; abs. in E. S. R., vol. IV, p. 259.

ABSTRACTS OF PUBLICATIONS OF THE AGRICULTURAL EXPERIMENT STATIONS IN THE UNITED STATES.

CHEMISTRY.

E. W. ALLEN, *Editor*.

On the Gunning-Kjeldahl method and a modification applicable in the presence of nitrates, A. L. WINTON (*Connecticut State Sta. Report for 1893, part III, pp. 171–174*).—This is a reprint of Bulletin No. 112 of the station (E. S. R., vol. IV, p. 336), with the addition of twelve comparisons of the method as modified for nitrates with the Schulze-Tiemann and Scovell-Jodlbauer methods.

The average of the 37 determinations by the Scovell-Jodlbauer method is 4.65 per cent, by the proposed method 4.66 per cent. The greatest discrepancy in any instance is 0.1 per cent, the average discrepancy 0.05 per cent. In 13 cases the proposed method gave the lower result, in 21 cases the higher result, and in 3 instances both gave the same result.

METEOROLOGY.

W. H. BEAL, *Editor*.

Rainfall record, W. H. HEILEMAN (*Iowa Sta. Bul. No. 23, p. 940*).—A record of rainfall (including melted snow) from March 1 to August 31, 1893.

FERTILIZERS.

W. H. BEAL, *Editor*.

Soils and fertilizers, part I, P. SCHWEITZER (*Missouri Sta. Bul. No. 19, Oct., 1892, pp. 30*).—This is a popular discussion of these subjects under the following heads: Formation, alteration, and properties of soils; the composition with reference to fertilizing constituents of different farm crops; principles underlying the use of manures, with fertilizer mixtures for different crops; and green manuring.

Results of experiments with fertilizers on different classes of soil, C. S. PHELPS (*Connecticut Storrs Sta. Bul. No. 10, Mar., 1893, pp. 16*).—This is a reprint of an article published in the Annual Report of the station for 1892 (E. S. R., vol. v, p. 573).

Coöperative soil tests with fertilizers on cotton, J. S. NEWMAN (*South Carolina Sta. Bul. No. 12, May, 1893, pp. 19*).—"For the purpose of studying the chemical defects of the different typical soils of the State," prepared fertilizers were furnished to 11 farmers in as many counties, with instructions as to the method of conducting experiments. The fertilizers used were nitrate of soda, cotton-seed meal, acid phosphate, floats, and kainit, singly and combined, and stable manure. The soils used were generally of a sandy character with sandy or clay subsoil. The yield of seed cotton at first and second picking, total yield, and increase due to the different fertilizers are tabulated. The results in a number of cases were inconclusive on account of irregularity of the soil selected and the unfavorableness of the season. In two cases at least (sandy loam with red clay or sandy clay subsoil) the results indicated that phosphoric acid was the element most needed, and that it hastened maturity; in one experiment (on sandy soil with yellow sandy subsoil) kainit gave the best results, although this might have been partly due "to the conservation of moisture by the kainit during the period of drought in July;" but the results in general appear to favor the use of a complete fertilizer.

General discussion on commercial fertilizers, C. A. GOESSMANN (*Massachusetts State Sta. Bul. No. 51, Mar., 1894, pp. 1–6*).—Brief popular statements are given regarding the selection, valuation, and use of commercial fertilizers, accompanied by a schedule of trade values of fertilizing ingredients for 1894.

Fertilizer inspection and analysis in North Carolina, H. B. BATTLE (*North Carolina Sta. Special Buls. Nos. 16, Feb. 24, 1894, pp. 9; 17, Mar. 10, 1894, pp. 12; and 18, Mar. 24, 1894, pp. 13*).—These bulletins give a digest of the State fertilizer laws, explanations of terms used in fertilizer analysis, notes on valuation, freight rates from the seaboard to interior points, and tabulated analyses and valuations of 214 samples of fertilizing materials, including compound fertilizers, acid phosphates, and kainit, collected during the season of 1894.

Fertilizer inspection and analysis in South Carolina (*South Carolina Sta. Buls. Nos. 11, Apr., 1893, pp. 16; and 13, July, 1893, pp. 25*).—Notes are given on methods of collecting samples, a schedule of rates of commercial valuations, and tabulated analyses and valuations of 272 samples of fertilizing materials, including ammoniated fertilizers, acid phosphates, cotton-seed meal, and kainit, collected during the season of 1893.

Fertilizer inspection and analysis in West Virginia, J. A. MYERS and R. J. DE ROODE (*West Virginia Sta. Bul. No. 34, Dec.,*

1893, pp. 273–285).—This bulletin gives general statements regarding the operations of the fertilizer control, advice as to the selection of fertilizers, schedules of trade values of fertilizing materials and notes on valuation, text of the State fertilizer law, directions for sampling, instructions to manufacturers and general agents, and tabulated analyses and valuations of 142 samples of commercial fertilizers.

FIELD CROPS.

J. F. DUGGAR, *Editor.*

A study of the ripening of corn, C. F. CURTISS and G. E. PATRICK (*Iowa Sta. Bul. No. 23, pp. 874–880*).—Five fifth-acre plats of corn were cut September 17 and 24, and October 1, 8, and 15, respectively, and shocked in the field. An adjoining plat of equal size was left standing in the field until December 17, when it was harvested. The corn on all the plats was husked December 17 and brought in, at which time samples were taken of the corn and fodder of each cutting and analyzed. The yield of corn on the different plats ranged from 53.6 to 64.3 bushels per acre, increasing gradually up to the fourth date of cutting. The analyses of the kernels, cobs, and stover from each plat are tabulated. From these data the following yields of nutrients per acre are calculated:

Calculated yield of nutrients per acre in corn at different cuttings.

	Stover.						Kernels.				
	Plat 1, cut Sept. 17.	Plat 2, cut Sept. 24.	Plat 3, cut Oct. 1.	Plat 4, cut Oct. 8.	Plat 5, cut Oct. 15.	Plat 6, left standing.	Plat 1, cut Sept. 17.	Plat 2, cut Sept. 24.	Plat 3, cut Oct. 1.	Plat 4, cut Oct. 8.	Plat 5, cut Oct. 15.
	Lbs.	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
Ash	337	272	282	303	196	118	44	50	50	44	47
Ether extract (fat)	38	38	4	11	5	6	.120	143	154	175	151
Nitrogen-free extract	1,740	1,924	1,526	1,708	1,659	1,019	2,196	2,355	2,558	2,577	2,299
Crude fiber	1,078	1,283	1,263	1,179	1,076	712	67	69	71	64	52
Crude protein	296	339	176	171	122	85	301	309	361	334	313
Total dry matter	3,489	3,856	3,321	3,372	3,058	1,940	2,728	2,926	3,194	3,194	2,862

Plat 1 was cut when the kernels were in what would be termed the "dough" stage, not quite all dented, and the stalks and leaves were yet entirely green; plat 2, corn well dented and the blades just beginning to dry; plat 3, corn well ripened and the blades about half dry; plat 4, corn thoroughly ripened and the blades and husks rapidly drying up; plat 5, blades and husks nearly all dry, only a few of the middle and more protected blades yet green, stalks also drying out considerable; plat 6, sample in the usual storm-beaten condition of Iowa stalk fields in December. * * *

It will be seen from these tables that the largest amount of dry matter in the stover was secured at the time of cutting the second plat, September 24, and the greatest amount of dry matter secured in the kernels was reached at the time of cut-

ting the third plat; and that the highest aggregate dry matter from an acre, 6,782 pounds, in the stover and kernels combined, was secured from the second cutting, and the next highest, 6,515 pounds, from the third cutting.

These results indicate that the best time for cutting the corn under investigation was from September 24 to October 1. * * *

The results show a striking loss entailed by [leaving the corn standing in the field until December], amounting, first, to nearly half the product in yield, and, second, a depreciation in feeding value.

Experiments with corn, R. H. MILLER and E. H. BRINKLEY (*Maryland Sta. Bul. No. 25, Mar., 1894, pp. 26–29*).

Synopsis.—The experiments come under the following heads: (1) Distance, (2) depth of cultivation, and (3) effect of lime and of manure from a poorly-balanced and from a well-balanced ration. The results were in favor of (1) narrow rows, (2) shallow cultivation, and (3) the application of lime; manure from a well-balanced ration gave slightly better results than that from a poorly-balanced ration.

Distance.—On 4 plats the rows were 3 feet 8 inches apart and the stalks 15 inches apart in the row; on 4 plats the rows were 5 feet apart and the stalks 12 inches in the row. The yield of grain was in the wide rows 46 bushels 38 pounds per acre, and in the narrow rows 50 bushels 52 pounds. The stover on the wide rows yielded 3,786 pounds, on the narrow rows 5,443 pounds per acre.

Depth of cultivation.—Cultivation to a depth of 3 to 3½ inches resulted in a yield of 44 bushels 31 pounds of corn and 3,212 pounds of stover per acre; to a depth of 5 to 6 inches, 38 bushels 46 pounds and 3,040 pounds of stover per acre.

Fertilizers.—The plat treated with lime yielded more stover and 34.7 per cent more corn than that receiving no lime. Manure from a well-balanced nitrogenous ration gave a yield of 38 bushels 36 pounds of corn and 2,544 pounds of stover per acre, against a yield of 37 bushels 34 pounds of corn and 2,288 pounds of stover with manure from a poorly-balanced ration.

Experiments with potatoes, R. H. MILLER and E. H. BRINKLEY (*Maryland Sta. Bul. No. 25, Mar., 1894, pp. 29–41*).—These embrace experiments with fertilizers, varieties, methods of cultivation, and treatment for scab and blight.

The use of fertilizers was not profitable. Of three varieties of potatoes tested Queen gave the largest yield. The rows which were hilled up at the last working, June 21, afforded a yield slightly larger than that resulting from flat culture. Subsoiling resulted in a considerable decrease in yield. Treatment of seed potatoes with corrosive sublimate solution largely increased the yield, and reduced the percentage of scabby merchantable potatoes from 41.9 per cent on the untreated plat to 8.4 per cent on the treated plat. Late digging did not increase the amount of scab. The use of Bordeaux mixture for blight increased the yield 41 per cent. Spraying July 26, August 13, and September 14 was more effective than spraying August 4, August 13, and September 4.

Experiments with potatoes, J. F. C. DU PRE (*South Carolina Sta. Bul. No. 9, n. ser., Mar., 1893, pp. 11*).—Experiments were conducted on distance, size of cuttings, and 47 varieties. Burbank potatoes were planted whole and cut to one and two eyes; the bud end, stem end, and middle portion of the tuber were also planted. The distance given was 36 by 20 inches. Pieces containing one or two eyes and those consisting of the bud end gave the largest yield, followed by whole potatoes, middles, and stem ends, in the order named.

Cuttings of Early Rose, containing one or two eyes, were used in the distance experiments. The largest yield was made when the distance was least, 36 by 12 inches. Tabulated data give the yields, time of maturing, keeping qualities, and brief descriptions of 47 varieties.

Coöperative test of sugar beets, I. P. ROBERTS (*New York Cornell Sta. Bul. No. 63, Mar., 1894, pp. 39–44*).—Beet seed was sent to 70 farmers in 51 counties in the State. Thirty farmers sent in samples of beets for analysis. In 31 samples analyzed the highest sugar content was 14.71 per cent. The largest yield was 44 tons per acre, and the smallest 7.05 tons. In 8 experiments Dippe Klein Wanzleben averaged 24.03 tons per acre, containing 12.86 per cent of sugar, and averaging 40.26 ounces as the gross weight of a beet. In 13 experiments Knauer Imperial yielded 26.19 tons per acre, containing 12.49 per cent of sugar; the beets averaged 39.55 ounces in weight. In 7 experiments Vilmorin Richest averaged 14.63 tons per acre, containing 13.19 per cent of sugar; the beets averaged 34.37 ounces in weight.

In 5 experiments on clay soil the average yield was 12.77 tons per acre, the average sugar content 12.54 per cent, and the average weight of individual beets, 31.8 ounces; on clay loam the yield was 22.24 tons per acre, containing 13.08 per cent of sugar, and averaging 31.76 ounces per beet; and on sandy loam and clay the average yield of 11 experiments was 27.98 tons per acre, containing 12.6 per cent of sugar, and averaging 45.87 ounces per beet. Different soils influenced the percentage of sugar less than did the variety.

Sugar beets in Iowa, 1893, G. E. PATRICK and O. H. PAGELSEN (*Iowa Sta. Bul. No. 23, pp. 925–939*).—Thirty-three farmers living in 20 counties sent samples of beets to the station for analysis. The average sugar content of 55 samples of beets was 11.94 per cent with a purity of 76.1. Eight farmers conducted a test to determine the effect of early and late harvesting on the character of the beets. The average results showed that early harvesting (October 2 to 9) gave beets with 11.53 per cent of sugar and 73.34 purity. Beets harvested October 26 to November 1 averaged 13.31 per cent of sugar and 81.66 purity. Tabulated data are given showing the results of analyses and details of culture.

Field experiments with sugar cane, W. C. STUBBS (*Louisiana Stas. Bul. No. 24 (second series), pp. 785–810*).

Synopsis.—Condensed meteorological records for 1886 to 1893, inclusive, are given and the effects of climatic conditions, methods of cultivation, and drainage are

discussed. Various experiments on planting cane are described. The results were in favor of (1) narrow rows, (2) distances of 12 to 15 inches between the plants in the row, (3) the use of the upper part of the cane for planting, (4) not more than a double line of canes in the planting furrow, and (5) not cutting seed cane. Results are inconclusive regarding the relative values of plant and stubble cane for seed.

From a study of the meteorological conditions for eight years, "we find that a dry warm winter followed by a moderately dry spring, and this in turn succeeded by a hot wet summer, are conditions favorable to maximum growth of cane. It seems, too, that a dry cool autumn, beginning early in September, is necessary to produce a large sugar content.

"After the cane is laid by frequent showers of considerable intensity appear highly beneficial, and if not supplied the crop will not reach the maximum tonnage."

In the cultivation of cane at the station the cultivator is used to the exclusion of the turn plow. The value of irrigation has not been thoroughly determined on account of seasonable rains. Drainage appeared to increase the tonnage, decreased the sugar content, and increased the resistance of cane to frost.

Experiments to determine the best width of rows were conducted on one series of plats for four years, on another series for three years, and on a third series for two years. Only the first series was tile-drained (in February, 1891). Striped cane only was used on the first series; both purple and striped cane on the others. The average results were as follows:

(1) For four years: Rows 3 feet apart yielded 31.66 tons of cane per acre; 4 feet, 30.76 tons; 5 feet, 33.96 tons; 6 feet, 31.54 tons; 7 feet, 31.45 tons; and 8 feet, 29.34 tons.

(2) For three years: Rows 3 feet apart yielded 31.11 tons per acre; 4 feet, 28.91 tons; and 5 feet, 28.25 tons.

(3) For two years: Rows 5 feet apart yielded 35.41 tons per acre; and 6 feet, 32.75 tons.

Purple cane does not increase in tonnage with decrease of width of rows, as does the striped cane. In fact the yield of striped cane is almost inversely as the width of rows. To determine the best distance in the row the buds were sprouted, and each sprout with the section of cane adherent to it planted at 6, 12, and 18 inches apart. The following table gives the results:

Effect of distance of planting on yield of cane.

Distance in row.	Number stalks per acre.			Average weight of stalks.	Yield.	Sucrose.
	March.	June.	At harvest.			
				Pounds.	*Tons.*	*Per cent.*
6 inches	17,600	72,325	39,050	2.17	42.55	9.10
12 inches	8,840	51,188	32,964	2.49	41.60	8.33
18 inches	5,865	37,230	29,070	2.60	37.24	8.99

Suckering depends largely upon room—the greater the distance apart the greater the number of suckers. It further appears that there is no practical end to the process of suckering, provided ample room for such multiplication be given. * * *
For practical purpose, it may be stated that plant cane, standing 12 to 18 inches apart in early spring, may fill up and make a most excellent crop by the fall.

The following figures give the average results of planting different parts of the cane for four years: The upper half yielded 38.60 tons of cane per acre; the middle third, 32.53 tons; and the lower third, 32.19 tons. The plats on which the lower half and upper third of the cane were planted were unfavorably situated and gave results lower than the above figures. The first year's experiments on the effect of planting yearly "tops from tops," "middles from middles," etc., are tabulated.

More than two lines of canes in the row planted without lap was found to be a waste of cane. In seasons when seed cane is scarce and of good quality one stalk with a good lap is recommended.

When cane was planted in the fall, cutting the seed cane reduced the yield the first year, but not in subsequent seasons.

Data regarding the relative value of plant cane and stubble cane for seed purposes are given, but no conclusions are drawn.

Tobacco, A. J. BONDURANT (*Alabama College Sta. Bul. No. 54, Feb., 1894, pp. 13–29*).—The record is given of an experiment in growing 14 varieties of tobacco; statements concerning the method of manuring, cultivating, and curing; and experts' reports on the character of the tobacco. Statistics are given on tobacco production in 16 States. The following table gives the yield of 14 varieties of tobacco grown at the station on "branch bottom" and on white sandy soil, liberally fertilized:

Yield per acre af cured tobacco on sandy bottom and white sandy upland soil.

Plat No.	Names of varieties.	Yield per acre of cured tobacco— On bottom land.	Yield per acre of cured tobacco— On upland.	Type.
		Pounds.	*Pounds.*	
1	Comstock Spanish	1,029.0	1,242.8	Cigar.
2	Connecticut Seed Leaf	1,268.4	1,505.4	Cigar.
4	Havana Seed Leaf	852.6	881.4	Cigar.
8	Vuelta de Abajo	1,436.4	439.4	Cigar.
13	Pure Havana	814.8	452.4	Cigar.
3	Conqueror	1,163.4	1,645.8	Plug.
5	Hester	1,192.8	998.4	Plug.
6	Hyco	1,247.4	1,591.2	Plug.
7	Long Leaf Gooch	1,159.2	1,294.8	Plug
9	Yellow Orinoco	1,310.4	1,744.6	Plug.
10	White Stem Orinoco	1,104.6	1,271.4	Plug.
11	Burley	1,176.0	1.235.0	Plug.
12	Gold Finder	688.8	720.2	Plug.
14	Yellow Pryor	575.4	860.6	Plug.

As far as experiments have progressed at the station, the indications are that tobacco of good quality, particularly for manufacturing plug, for pipe smoking, and cigarettes, and possibly for cigars, can be raised in this part of Alabama at a profit.

From samples sent to the station for examination, from different parts of the State, it is fair to conclude that in that portion of the State bordering on the Gulf coast tobacco of good quality, fine flavor for wrappers, binders, and fillers for cigars, can be produced.

HORTICULTURE.

Varieties of beans, J. F. C. DU PRE (*South Carolina Sta. Bul. No. 10, n. ser., Apr., 1893, pp. 8*).—Brief notes on 34 varieties of beans. Of the dwarf beans the wax varieties were more generally injured by rust than the green-podded varieties. The following did well: Flageolet Wax, Yosemite Mammoth Wax, Long Yellow Six Weeks, Early Red-Eye China, Early Red Valentine, Henderson Earliest Valentine, Red Speckled Valentine, and all of the strains of Refugee. Of the pole beans, Golden Wax and Early Golden Cluster Wax were preferred.

Results of crossing cucurbits, L. H. PAMMEL (*Iowa Sta. Bul. No. 23, pp. 906–917, figs. 3*).—The crop of 1893 from seed produced in 1892 confirmed the results of previous experiments, reported in Bulletin No. 19 of the station (E. S. R., vol. IV, p. 726), and led to the following conclusions:

(1) That pumpkins (*Cucurbita pepo*) and squashes (*Cucurbita maxima*) will not hybridize.

(2) That pumpkins and watermelons (*Citrullus vulgaris*) will not "mix," nor will squashes and melons "mix."

(3) Cucumbers (*Cucumis sativus*), sugar [melons] and muskmelons (*Cucumis melo*) will not hybridize, nor will they "mix" with pumpkins.

(4) The different forms of *Cucurbita maxima* will readily cross with each other.

(5) The forms of *Cucurbita pepo*, such as the Long Warted, Nest Egg Gourd, Vegetable Marrow, New Golden Bush, Bush Scalloped, Italian Striped, Perfect Gem, Common Pumpkin, and Sweet Sugar, will readily cross with each other.

(6) The hermaphrodite flowers of muskmelon are self-impotent, and this is true also of some squashes.

(7) Certain varieties are prepotent, as shown in character of fruit, vine, and leaf. The prepotency is, however, often not well defined, both parents transmitting equally.

The use of sand cherries for stocks, J. L. BUDD and N. E. HANSEN (*Iowa Sta. Bul. No. 22, pp. 852–855*).—Five varieties of plums, 1 of peaches, and 4 of cherries were crown grafted on the sand cherry stock. A large proportion of the grafts failed to grow. "The sand cherry is not a desirable stock or else it needs special management and treatment which we do not as yet understand." Nine varieties of plums and 6 varieties of cherries were budded on the sand cherry and most of the buds united. "The sand cherry stock is not as favorable for rapid work as the Mahaleb on account of its numerous branches close to the ground."

Vegetables and small fruits, J. S. ROBINSON (*Maryland Sta. Bul. No. 25, Mar., 1894, pp. 42–53*).—General statements are made on cul-

tivating, marketing, and fertilizing tomatoes; notes on the insect and fungus foes of the grape and strawberry; brief statements regarding cantaloupes. watermelons, blackberries, raspberries, and potatoes; tabulated data giving the gross and net prices of tomatoes in the markets of Baltimore, Washington, Wheeling, and Pittsburg; and notes on 22 varieties of tomatoes and 43 of strawberries.

Treatment is suggested for the scale insect of the grape and the strawberry root louse (*Aphis forbesi*), and reference is made to the injury done by the strawberry weevil (*Anthonomus musculus*).

Of the four markets mentioned Pittsburg was the most profitable for a shipment of tomatoes made August 2, the net returns in that market being $1.58 per bushel; in the Wheeling market, 84 cents; and in the Washington and Baltimore markets 12 cents.

The best early varieties of strawberries were Michel Early, Hoffman, and Van Deman. Gandy was the best of the late varieties. The Netted Gem was the earliest cantaloupe. The Early Harvest and Wilson, Jr., raspberries were preferred to all others tested.

Variety tests of garden vegetables, F. A. WAUGH (*Oklahoma Sta. Bul. No. 9, Jan., 1894, pp. 1–37*).—Descriptive notes are given on 6 varieties of peas, 15 of beans, 30 of muskmelons, 36 of watermelons, 23 of cucumbers, 7 of beets, 5 of radishes, 15 of lettuce, 7 of potatoes, and 6 of turnips. The following are commended: Champion of England pea; Henderson Bush Lima bean; Jenny Lind, Perfection, and Banquet muskmelons; Hungarian Honey, Mountain Sprout, Jones Jumbo, and Vick Extra Early watermelons; Wethersfield Chicago Pickle cucumber; Long Dark Blood, Early Blood Turnip, and Early Red Turnip beets; White Strasburg radish; Hanson, Boston Market, and New York lettuce; Beauty of Beauties potato; Early White Flat Dutch turnip; and Mammoth Sandwich Island salsify. A glossary of scientific terms used in the description of varieties is given.

The Japanese plums in North America, L. H. BAILEY (*New York Cornell Sta. Bul. No. 62, Jan., 1894, pp. 36, pls. 3, figs. 12*).

Synopsis.—Descriptions of 33 named varieties with statements regarding the dissemination in America, the botanical relationships, and the economic characteristics of Japanese plums. A list of varieties subject to injury by spring frosts at different localities, the record of the dates of blooming of 15 varieties at Denton, Md., and notes on the weaknesses and diseases of Japanese plums are given.

In this bulletin the Japanese class names are discarded and the following classification adopted:

Yellow-skinned plums—Georgeson, Normand, Kerr, and Ogon.

Red-skinned plums, yellow flesh—Abundance, Berckmans, Burbank, Kelsey, Long Fruit, Munson, Perfection, Strawberry, Babcock, Bailey, Berger, Chabot, Maru, Orient, Red Nagate, Willard, and Yosebe; red flesh—Delaware, Heikes, Satsuma, Hale, Late Blood, and Uchi-Beni.

The following summary is taken from the bulletin:

(1) Twenty-four years ago a plum was introduced into California from Japan which proved to belong to a species heretofore unknown in America. It was first

fruited by the late John Kelsey, of Berkeley, Cal., and for him it was named. It began to attract wide attention about ten years ago.

(2) This plum belongs to the species *Prunus triflora*, which is supposed to be native to China, but which is unknown in a wild state. Subsequent importations have been made from Japan, and at the present time about thirty varieties are more or less known and disseminated.

(3) These Japanese plums are distinguished from the common Domestica plums by their generally more pointed or heart-shaped fruit which has a deep groove or suture upon one side, by a longer-keeping flesh and generally a less winged pit. In other botanical features they differ in commonly bearing three or more winter buds at a joint, instead of one, in the light-colored rough bark, flowers usually in twos or threes, leaves long-obovate or elliptic and finely serrate. They are closely allied in botanical characters to some types of native plums.

(4) The nomenclature of the varieties is much confused, largely because the Japanese names are used for groups or classes and not for specific varieties; and there is no uniformity even in the generic application of these names. It is essential to an exact understanding of this fruit, therefore, that the Japanese class names be discarded in this country.

(5) While importations from Japan have been made freely, there are probably many more good varieties in that country which have not reached America; but we must look for most permanent progress in the future from American offspring.

(6) The Japanese plums differ amongst themselves greatly in hardiness. The Kelsey is adapted only to the States south of Virginia and to the warmer parts of the Pacific coast, but other varieties are fully hardy in parts of Connecticut, Ontario, New York, and Iowa.

(7) The varieties now known to be hardy in the plum regions of New York are Burbank, Abundance, Willard, Ogon, Satsuma, Chabot, Yosebe, and Berger; and others give promise of being as hardy as these.

(8) The period of ripening of the various kinds extends over a long season, running, in New York, from the middle of July to the middle of September. The same variety does not always appear to ripen at the same period in successive years. This is especially true of the Kelsey, which sometimes varies through a period of three months. In New York, the earliest market variety which has been tested appears to be Willard, followed closely by Ogon, then Abundance and Berckmans, and Burbank still later. Kelsey is generally the latest of all the varieties.

(9) Most of the Japanese plums keep for several days, and some of them even for two weeks, after they are ripe. Satsuma is one of the best keepers known in the north.

(10) The larger part of the varieties are red with deep yellow flesh, and the Satsuma and a few varieties less known, have deep red flesh. There are only four well-known yellow varieties. There are eight freestones, as follows: Ogon, Willard, Kelsey, Berger, Maru, Munson, Normand, Yosebe.

(11) The varieties which can be most confidently recommended at the present time are Abundance, Burbank, Willard, Kerr, Berckmans, Maru, Red Nagate, Chabot, Satsuma, and perhaps Ogon. Kelsey is recommended for the South.

(12) The chief weaknesses of the Japanese plums are too early bloom of some varieties and liability to the fruit-rot fungus. Amongst their advantages are partial immunity from black knot and leaf blight, and often a partial freedom from curculio injury.

(13) Altogether the Japanese plums constitute the most important type of fruit introduced into North America during the last quarter of a century, and they should receive careful tests in all parts of the country.

Experiments with small fruits, J. TROOP (*Indiana Sta. Bul. No. 48, Jan., 1894, pp. 14*).—Notes and tabulated data are given on varieties of strawberries, raspberries, blackberries, currants, and gooseberries;

condensed reports on varieties of small fruits grown at the substations in Lagrange, Marion, and Floyd counties, and a suggestion regarding the use of irrigation by small fruit culturists. Of 81 varieties of strawberries tested Brunette, Bubach No. 5, Katie, Greenville, Parker Earle, Enhance, Lovett, and Warfield are recommended for the home garden. Of 26 varieties of raspberries Cuthbert and Thompson Early were the best among the reds, and ranked high in hardiness and productiveness. Of the blacks Conrath, Cromwell, and Kansas proved to be promising new varieties. Twenty-one varieties of blackberries are reported on. Early Harvest proved to be too tender, Topsy lacked productiveness, and Windom lacked both vigor and productiveness. Farmers are cautioned against planting the Evergreen blackberry. Twelve varieties of currants and 7 of gooseberries were tested; of the latter Champion, Downing, and Early Orange are recommended, either for family use or for market.

A brief note on irrigation in fruit culture is given.

A stream of water 1 inch wide and 1 inch deep flowing at the rate of 4 miles an hour will supply 25,920 gallons in twenty-four hours, or sufficient to cover 1 acre nearly 1 inch deep.

Brief notes on the gooseberry sawfly (*Nematus ventricosus*) and the currant borer (*Sesia tipuliformis*) are given.

Red raspberries and distribution of plants, L. F. KINNEY (*Rhode Island Sta. Bul. No. 27, Mar., 1894, pp. 8–11, figs. 3*).—Brief notes are given on the raspberry crop of Rhode Island, on 7 varieties of raspberries, and on the treatment of raspberry plants. Cuthbert proved superior to all other kinds in the station trials. A few raspberry, strawberry, and chrysanthemum plants will be distributed by the station to residents of the State.

Varieties of fruits, W. M. MUNSON (*Maine Sta. Bul. No. 6, Jan., 1894, pp. 3*).—Lists of varieties of apples, pears, plums, cherries, blackberries, raspberries, currants, gooseberries, strawberries, and grapes recommended for culture in different portions of the State.

Rose hybrids, J. L. BUDD and N. E. HANSEN (*Iowa Sta. Bul. No. 22 pp. 856–861*).—In most of the crosses made the Russian type of *Rosa rugosa* was used as the pistillate parent. Many varieties of cultivated roses, mainly of the Hybrid Perpetual and Tea classes, supplied the pollen. Thirteen hundred flowers were crossed and 20,000 seeds secured. General Jacqueminot was used as the staminate parent in 497 cases. With this cross the results were as follows:

> (1) The staminate parent, Gen. Jacqueminot, has materially modified the foliage.
> (2) The hybrid seedlings greatly exceed the pure seedlings in vigor of growth.
> (3) The hybrid seedlings show a tendency to early blooming not indicated by the pure rugosa seedlings. * * *
> Our experience in these crosses and in all our crosses of the orchard fruits indicates the best results from the use of very dry pollen. * * * In some cases we secured a good stand with that only partially dried.

DISEASES OF PLANTS.

WALTER H. EVANS, *Editor.*

Pear leaf blight, L. F. KINNEY (*Rhode Island Sta. Bul. No. 27, Mar., 1894, pp. 3–7, figs. 7*).—Illustrated descriptions and notes on the treatment of the pear leaf blight (*Entomosporium maculatum*). Four trees were selected during the past season for treatment for leaf blight. The treatment given all the trees was essentially the same, and consisted of five applications of Bordeaux mixture prepared by the usual formula. The dates of application were May 9 and 30, June 20, July 11, and August 2. The check trees had their foliage and fruit entirely destroyed by the leaf blight, while those treated made thrifty growth during the summer and bore a considerable quantity of large and fair fruit. In every case the treatment given was sufficient to protect the trees from injury by the leaf blight and produce a good crop of fruit, while all other trees standing in the vicinity were attacked by the disease, which caused their leaves to fall and entirely ruined the fruit.

In order to determine the exact amount of copper which might adhere to the fruit, ten pears which had the mixture still visible on the stem and calyx ends were gathered from a treated tree. These were peeled and a chemical analysis of skin and stems was made. The average amount of copper oxide found adhering to the entire surface of the pear was only 0.016 of a grain. At this rate it would require 62½ pears to contain one grain of copper oxide or approximately the same amount of copper that would occur in 3.14 grains of copper sulphate. It has been shown that 0.5 of a gram or 7.719 grains of copper sulphate per day may be absorbed for some time without injury to the health. This shows that fruits properly sprayed with Bordeaux mixture or any other copper compound are not poisonous.

Experiments in preventing pear scab, S. A. BEACH (*New York State Sta. Bul. No. 67, Feb., 1894, pp. 183–204, figs. 2*).—Experiments were made during 1893 to test the efficacy of dilute Bordeaux mixture against pear scab, and to compare the value of three sprayings with two sprayings before the blossoms open. Since dilute Bordeaux mixture has given such good results when used against apple scab its effect was also tested against the pear scab. No attempt was made to compare the merits of different fungicides.

Some varieties of pears in the orchard were particularly susceptible to the attacks of the scab, and on account of its presence for several years had produced comparatively little first-class fruit. Two of these varieties, namely, the White Doyenné and Seckel, were selected for the treatment. The White Doyennés were used simply to test the value of the Bordeax mixture and the Seckel trees were used for the double purpose of testing the Bordeaux mixture and of comparing the value of two and three applications before blooming.

The Doyenné trees were sprayed May 10, 19, and 31, and June 12 and 28. The Seckels were sprayed May 2, 10, 19, and 31, and June 12 and 28. On July 18 it was noted that nearly every fruit on the lower branches of the sprayed trees was perfect, while on the unsprayed trees nearly every fruit was blemished by the scab. This difference between the sprayed and unsprayed fruit became more noticeable as the season advanced.

The fruit was picked the fourth week in September and assorted into three grades—firsts, seconds, and culls. No use was made of the culls. The prices realized for the different grades of fruit were as follows:

Comparative value of sprayed and unsprayed pears.

	Sprayed	Unsprayed.
Seckel:		
Firsts	$2.25 to $2.75 per bushel	$1.25 to $1.75 per bushel.
Seconds	$1.75 to $2 per bushel	$1 to $1.30 per bushel.
White Doyenné:		
Firsts	$4.50 per barrel ($1.80 per bushel)	None.
Seconds	$3.25 per barrel ($1.30 per bushel)	$2 per barrel (80 cts. per bushel).

Without counting the cost of the extra packages and handling of the increased yield, the gain from treatment of the Seckel variety was from $4.77 to $5.57 per tree, and the White Doyenné $6.10 per tree. The cost of treatment for six applications was 55.3 cents, and for five applications 47.6 cents. The total gain per 100 trees from the spraying varied from $423.10 to $562.40. The increased value of the fruit does not express the entire gain, as the foliage of the sprayed trees was much more healthy than that of the unsprayed, and the sprayed trees made a much better growth.

Illustrated notes are given on the cause of the pear scab (*Fusicladium pyrinum*). The number of sprayings profitable in an ordinary season has not yet been definitely determined, and no doubt in rainy seasons more frequent applications and stronger solutions will be found necessary than in dry seasons, but it is probable that the amount of copper sulphate can not be profitably reduced below 1 pound to 11 gallons of mixture. Directions are given for the preparation of Bordeaux mixture, and suggestions as to the weighing and straining of lime. The author recommends the potassium ferrocyanide test, showing an excess of lime, as more convenient than that of weighing. He prefers the use of fresh Bordeaux mixture, but conducted experiments on a stock solution of copper sulphate, and found that for all practical purposes a solution containing 2 pounds of copper sulphate per gallon may be safely used. Two gallons of such a solution would make 45 gallons of Bordeaux mixture. Notes are given regarding spraying in rainy weather, and on the kinds of apparatus used.

The author's summary is as follows:

(1) In these experiments pear scab was successfully treated by dilute Bordeaux mixture containing 4 pounds of copper sulphate to 45 gallons of the mixture.

(2) Comparing three treatments after the buds begin to open and before the blossoms open with two treatments during the same period, it is still doubtful whether enough benefit may be gained from the former to justify the expense of the extra treatment.

(3) In order to treat pear scab successfully the spraying must be done thoroughly and at the right season.

(4) The benefits of the treatment extend to the tree as well as the fruit, as shown by the increased vigor of the foliage and fruit on the sprayed trees when compared with the unsprayed trees.

A bibliography of pear scab and its treatment concludes the bulletin.

Spraying potatoes, L. R. JONES (*Vermont Sta. Bul., No. 40 Dec., 1893, pp. 32, figs. 17*).—The author reports upon the occurrence of the early blight (*Macrosporium solani*) and of the late blight (*Phytophthora infestans*), and urges the value of preventive treatment. The early blight has apparently become of importance only recently. It is worse on early potatoes, and attacks only the vines, reducing their yield through the premature death of the plant. Cool dry weather does not check the spread of this disease.

The late blight has been long known, and is worse in its attack upon the late potatoes, being most abundant in August and September. It progresses rapidly during warm moist weather and attacks the leaves, where it occurs as a mildew, and the tubers, causing them to rot.

The use of Bordeaux mixture for both these diseases is recommended. The author tested several fungicides on potatoes, but found, as before, that Bordeaux mixture gave the best results. The use of Bordeaux mixture on the different plats showed gains of from 20 to 230 bushels per acre over the check plats.

Among the most interesting results were gains where soap was added to the fungicide. In the author's opinion, the difference may be attributed largely to the effect of the soap upon the flea beetles rather than to its increased fungicidal action. Numerous leaves were taken at random and carefully counted, and those to which the soap had been applied showed a great reduction in the number of punctures by this insect.

The time and rate of growth of potato tubers, and hence the effect of the premature death of potato tops upon the yield, was investigated, and it was shown that the yield of marketable tubers increased with the different dates of digging until October 1. The rows used in this test had been thoroughly sprayed with Bordeaux mixture and the plants remained green until the end of September. Harvestings were made, beginning August 2 and continued every ten days until September 22. The yield August 2 was at the rate of 58 bushels per acre, the tubers averaging 1.6 ounces. The yield at the last digging, September 22, was 379 bushels per acre, the tubers averaging 5.7 ounces, showing the importance of preventing the early destruction of the vines.

The cart for spraying potatoes is figured and described.

Potato blights and their remedies, L. R. JONES (*Vermont Sta. Bul. No. 36, pp. 4, figs. 5*).—This is a popular bulletin on the subject of the

early blight (*Macrosporium solani*) and the late blight, or rot (*Phytophthora infestans*), of the potato, with suggestions as to their treatment. The author estimates that one fourth of the crop in Vermont for the last four years has been lost, due to these diseases.

Notes on a few common fungus diseases, L. H. PAMMEL (*Iowa Sta. Bul. No. 23, pp. 918–924, figs. 2*).—Brief popular accounts are given of an occurrence of plum and cherry scab (*Cladosporium carpophilum*), apple powdery mildew (*Sphærotheca mali*), grape downy mildew (*Plasmopara viticola*), grape powdery mildew (*Unicinula necator*), and rose powdery mildew (*Sphærotheca pannosa*). Attacks of the fungi are described and preventive treatments suggested.

ENTOMOLOGY.

Notes on injurious insects, H. OSBORN and F. A. SIRRENE (*Iowa Sta. Bul. No. 23, pp. 881–905, figs. 8*).

Synopsis.—Popular notes on the wheat head army worm, clover hay worm, clover seed caterpillar, leaf folder, leaf skeletonizer, cabbage worm, cheese mite, plant lice affecting grass roots, and the life history of a common plant louse.

The wheat head army worm (pp. 881–883).—This insect (*Leucania albilineata*) was conspicuous during the past season by the destruction it caused in certain parts of the State. The most damage seems to have been done in the northeastern portion of the State. In 1887 it was abundant in the southeastern part of the State, and the loss due to its presence in one county was placed at $150,000. The insect is figured and described as follows:

The insect is seldom noticed except at the time when it is working upon the heads of wheat or grass, and this is usually during July. At this time it is a small green worm, but it rapidly grows to maturity and becomes full grown by the time that the wheat ripens, and at this time enters the ground and changes to the pupa stage. From these pupæ a brood of moths appears during the last of July or in the early part of August. These deposit eggs which produce larvæ by the latter part of August. These larvæ, however, seldom attract attention, because they work promiscuously upon various grasses, and unless remarkably abundant do not cause any such extensive injury as to attract attention. These larvæ become full grown during autumn, change to pupæ in the ground, and remain in this stage until the following spring. In the spring moths issue, generally in the month of May, and deposit eggs upon grass or wheat, these producing the larvæ which become so conspicuous in feeding upon the heads of wheat and timothy.

The means for its repression are parasitic insects, spraying with London purple or Paris green, and catching the moths with lantern traps.

Clover hay worm and clover seed caterpillar (pp. 883–887).—Brief illustrated descriptive notes are given on the clover hay worm (*Asopia costalis*) and the clover seed caterpillar (*Grapholitha interstinctana*), with suggestions for their destruction. These insects have been pre-

viously noted in Bulletins Nos. 15 and 19 of the station (E. S. R., vols. III, p. 784; IV, p. 730).

The leaf folder and leaf skeletonizer (pp. 887–891).—The leaf folder (*Teras minuta*) and the leaf skeletonizer (*Pempelia hammondi*) are figured and described. The past season they were very destructive to nursery stock. The use of arsenites is recommended for their destruction. The authors state that *Teras cinderella* and *T. malivorana* are identical, one being the summer and the other the winter form, and both belonging to the species *T. minuta*.

Cabbage worms (pp. 891–894).—Notes are given on the repression of attacks of *Pieris rapæ* by means of hand catching and the use of pyrethrum, arsenites, parasites, and diseases. The authors consider taking them in hand nets as one of the safest and best methods of prevention.

Cheese mite (pp. 894, 895).—*Tyroglyphus siro* is popularly described and suggestions given for protecting cheese from its attack.

Plant lice affecting grass roots (pp. 895–901).—It having been established that *Schizoneura corni* spends part of its life cycle upon the dogwood and part upon the roots of annual grasses of little economic importance, investigations were conducted to ascertain whether it might not affect some of the more valuable forage grasses. The Setarias and Panic grasses were most affected by the root lice. In addition to this species, *Andropogon furcatus*, *Spartina cynosuroides*, and *Muhlenbergia racemosa* were more or less injured by their attacks. The authors' conclusions are as follows:

There seems to be one form of root lice infesting roots of perennial grasses and characterized by being of a yellow color in the apterous and pupal forms, while the winged forms are of the same color with dusky or black antennæ, head, prothorax, and wing callosities, and by a dusky or brown area on abdomen. Third joint of antennæ, with from 5 to 8 sensory pits, joints 4 and 5, two each, and joint 6 with 1 pit; also by having the peculiar habit of the brood next to the last migrating from the grass roots to dogwood and depositing a brood of wingless males and females on the leaves, the latter depositing their eggs on the rough bark. The eggs hatch about the middle of May. We have observed that the first brood feeds on the tender stems, base of leaves, and in flower clusters of the dogwood. The second brood, as far as observed, feed altogether in the flower clusters till full grown, when they develop wings and migrate from June 1 to 15 back to perennial grasses.

Another form infesting annual grass roots, characterized by having body of a dirty white color, antennæ, head, prothorax, and wing callosities slightly dusky. Two dusky or grayish bands on abdomen, 1 to 3 sensory pits on third antennal joint, joints 4, 5, and 6 each with 1 sensory pit. Winged forms smaller than those on perennial grasses, antennæ and wings shorter; the venation, of the latter being very variable; also by not having a fixed migratory habit, winged forms being rarely produced and these not appearing at fixed periods.

That the latter is a distinct species from the first we are not prepared to say. Some specimens show such strong resemblance in structural characters to true *Schizoneura corni*, varying only in color and size, we are inclined to think that it is simply a dimorphic form, possibly a variety brought about by the fostering care of ants. If the latter is allowable it seems that their life cycle is as follows: The eggs are deposited in the dirt, though they have not been found on roots of annual grass nor in the chambers of ants, as noted by Lubbock.

In the spring the lice are gathered either before or after hatching, probably the latter, and carried by the ants to the roots of shepherd's purse, where they feed till June or the first of July, at which time this weed ripens its seeds and dies, when they are transferred to roots of foxtail and possibly corn. As the foxtail dies early in the fall they are again transferred to Panicums, in the dirt around the roots of which they deposit their eggs.

Unless the root lice are transferred to corn their attack upon the annual grasses is of little importance. They may do considerable damage to some of the perennial grasses. If troublesome to corn thorough cultivation, rotation of crops, and the destruction of all dogwoods are advised.

Life history of a common plant louse (pp. 901–905).—The identity of *Aphis euonymi* and *A. rumicis* is established. The aphis migrates twice a year—from May 23 to June 10—from the waahoo to various annual weeds, and from September 15 to October 1 back to the waahoo, where its eggs are deposited around the buds. This louse can and does live upon the common snowball (*Viburnum opulus*) and may be destroyed by spraying with kerosene emulsion.

Defects in wood caused by insects, A. D. HOPKINS (*West Virginia Sta. Bul. No. 35, Jan., 1894, pp. 289–306, figs. 26*).—The author gives illustrative descriptive notes on various defects in wood caused by insects. Pin holes in heart wood of chestnut and oak and in sapwood of apple and spruce, worm holes in sap and heart wood of various kinds, and black holes and stains in white oak are figured and the insects causing them figured and described. Other kinds of destruction caused by insects are also mentioned.

The losses resulting from the presence of insect injuries in wood are grouped under two heads—the depreciation in value of otherwise sound lumber and timber, and the premature decay resulting from the presence of the holes which allow moisture and fungi access to the inner part of the lumber. The total amount of loss caused by these injuries varies greatly with the kinds of timber and the different localities and ranges from 2.5 to 50 per cent of the total output, in some cases causing a depreciated value sufficient to reduce the value of lumber below the cost of production.

In combating the attacks of wood-infesting insects, the author states that preventive and precautional methods must be adopted, as little can be done in the way of destroying the insects after their ravages have begun. With the knowledge of the habits of the insects simple means can usually be adopted for preventing their attack. Removing the bark from logs before the time for the depositing of the eggs will in most cases prevent the injury. As precautionary means to be adopted, the author recommends the burning of all useless material which would favor the breeding and increase of destructive species, and also the consideration of the proper time at which timber should be felled, as trees felled just before the period at which the eggs are laid are much more subject to the attack than those felled later in the season.

Insects and insecticides, J. W. TOUMEY (*Arizona Sta. Bul. No. 9, Nov., 1893, pp. 10*).—Popular notes are given on the description, occurrence, and means for combating the cañaigre beetle (*Gastroides cæsea*), the green June beetle (*Allorhina sobrina*), locust bagworm (*Thyridopterix* sp.), procris worm (*Procris americana*), twelve-spotted vine beetle (*Diabrotica tenella*), plant lice (*Aphides* sp.), and scale insects. Directions are given for the preparation and use of different insecticides.

FOODS—ANIMAL PRODUCTION.

E. W. ALLEN, *Editor.*

Analyses of fodder articles (*Massachusetts State Sta. Bul. No. 51, Mar., 1894, pp. 6–8*).—Analyses are given with reference to food ingredients of late soja bean, early black soja bean, early white soja bean, Peoria gluten meal, Iowa gluten meal, King gluten meal, rye feed, and oat feed; and with reference to both food and fertilizing ingredients of rowen hay, carrots, beets, and potatoes raised on three different plats. The analyses of 4 samples of green soja bean are as follows:

Analyses of green soja beans.

	Moisture.	In dry matter.					
		Crude ash.	Crude cellulose.	Crude fat.	Crude protein.	Amide nitrogen.	Nitrogen-free extract.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Late soja bean	77.09	14.36	16.47	3.34	22.16	0.79	43.67
Early black soja bean	82.21	12.86	25.06	3.38	16.18	0.55	42.52
Early white soja bean	79.51	14.36	23.41	2.97	14.34	0.68	44.92
Early white soja bean	74.97	11.85	23.23	2.16	13.81	0.31	48.95

The samples were all taken before blooming, although the early black soja bean and the first sample of the early white soja bean were taken just as the plants were about to bloom.

Soiling, J. WILSON (*Iowa Sta. Bul. No. 23, pp. 865–873*).

Synopsis.—A trial of soiling 4 cows with green oat and pea fodder, clover, rape, and fodder of sweet corn. These crops, with the exception of rape, all increased the yield of milk and in some cases the percentage of fat, as compared with a blue grass pasture. The best flavored butter was made on sweet-corn fodder; that made on rape was judged of inferior flavor.

Four cows—a Shorthorn, Holstein, Red Poll, and Jersey—were selected from the herd for an experiment in soiling. They had been grazing on a good blue grass pasture and had received 4 pounds of corn meal per day in addition. The soiling commenced July 21, feeding green oat and pea fodder. Following this green clover, rape, and sweet-corn fodder were each fed separately in short periods of about ten

days. From 110 to 125 pounds of the soiling crops was fed per cow daily, together with the 4 pounds of corn meal. September 10 the cows were turned back to pasture. The milk was weighed and tested in each period and a part of it used for butter-making. The data secured and the composition and scoring of the butter are tabulated.

"Taking cows from an abundant pasture at this season, keeping them confined in a barn, and feeding them all they would eat of peas and oats resulted in an increased flow of milk from all."

The effect of the different kinds of soiling was not always uniform with different cows. As a rule, however, "peas and oats had an immediately beneficial effect over pasture conditions, both as regards the quantity of milk and its quality. The clover did not maintain either entirely. * * * On rape there was a general shrinkage of milk and the fat per cent dropped in all except the Jersey. * * * The sweet corn did not make much variance in quantity of milk. * * * The cows shrunk seriously as soon as they were turned outdoors. * * * The milk from all the tested soiling crops made good butter except that from rape," which was inferior in flavor.

The low scoring on flavor for the rape butter was not because of deficiency of flavor, but because of a positively bad flavor, supposed to have been imparted by the feed. * * *

The butter [made on rape] became offensive in a few days after it was made. The chemical analysis shows that it is not very different from blue grass, peas, and oats, or clover; but this trial for dairy purposes gives unfavorable indications. That this is the case when the rape plant is made so large a per cent of the ration does not condemn it for dairy purposes, because plants as rich in protein as it is are rare, and may be very advantageously fed in less amounts.

The indications from sweet corn confirm what Iowa dairymen have believed concerning it. The butter from it scored highest.

Blue grass, peas, oats, and clover, rated at 42 points, make butter that sells in the highest classes, while corn butter excels them.

Experiments in pig feeding, H. T. FRENCH and C. D. THOMPSON (*Oregon Sta. Bul. No. 28, Jan., 1894, pp. 35–48, plates 4*).—This work includes two separate experiments which are more or less in continuation of experiments reported in Bulletin No. 20 of the station (E. S. R., vol. IV, p. 483).

Experiment No. 2 (pp. 35–40).—This experiment included 4 pigs, crosses of Poland China and Berkshire, which were divided into two lots. The weight of the pigs at the beginning of the trial varied from 215 to 240 pounds each. Lot 1 received chopped oats or wheat and lot 2 received a mixture of chopped oats, wheat, and shorts, to which bran was added in one period. The trial lasted from September 1 to December 22, and for convenience was divided into four periods.

The food for each lot remained practically the same throughout the trial. The food for both lots was soaked for a time before feeding. Salt and charcoal were given. Data for the experiment, including gains in weight, food consumed, and shrinkage and weight of parts at

slaughtering are tabulated; and reproductions are given of photographs of sections of the carcass of each pig. The total gains in weight were:

Lot 1. Chopped oats or wheat.

	Pounds.
No. 1	253
No. 2	263½

Lot 2. Mixed grain.

	Pounds.
No. 3	187½
No. 4	228½

Taking an average of the several periods, we find that it required 5.02 pounds of grain to make 1 pound of gain in lot 1, and 6.12 pounds in lot 2.

In round numbers, lot 1 consumed 2,447½ pounds of grain, at a cost of $19.41, or 3.9 cents for each pound of gain in live weight. In this case wheat was valued at 45 cents per bushel, the price paid at the time of thrashing the grain. Oats was reckoned at 36 cents per bushel.

Lot 2 consumed 2,325 pounds of grain, which figures the same as in lot 1, $19.41, or 4.66 cents for each pound of gain in live weight. The latter increase per pound is due to a smaller total gain in live weight. Wheat and oats were figured at the same price as in lot 1, bran at 75 cents per hundredweight, and shorts at 90 cents. These prices make the by-products bran and shorts cost more than wheat, which is the case at the present time. * * * The results are such as to dispel all doubts from the minds of those who have thought that wheat could not be made to produce pork equal in quality to corn-fed pork. From the cuts made from photographs it will be seen that the fat was very heavy and thick, and, although not shown by the cuts, it is very firm in texture.

The lean meat was very juicy and light in color, which characteristic has marked all of the results in feeding wheat to pigs thus far carried on at our station. In the rate of gain produced the results will compare favorably with those obtained from feeding corn. By referring to the table showing results by periods it will be seen that during the first period it required a larger amount of grain to produce 1 pound of gain in lot 1 than in lot 2, and this is the only period during which this is true. It was very noticeable, also, that the pigs did not enjoy the pure chopped oats. This fact was noted in previous experiments. The pigs do not like the coarse hulls which are present in such abundance in chopped oats. During the second period chopped wheat was substituted for the oats, and there is a much better showing in favor of this material.

During this period there was 13½ pounds of gain for each bushel of wheat consumed. This is a significant fact to those who are discussing the practicability of feeding wheat to pigs instead of selling at present prices.

Experiment No. 3.—This experiment was made to compare wet and dry feed. Four Berkshire pigs two and a half months old were used for the trial, which lasted from January 1 to December 30. They were divided into two lots, a sow and a barrow in each lot. The food was the same for both lots, and consisted of shorts from July 1 to September 5, and subsequently of a mixture of equal parts of chopped wheat, oats, bran, and shorts fed *ad libitum*.

The food of lot 1 was given dry and that of lot 2 was thoroughly wet with cold water and allowed to stand from one feed time to the next. Fresh water was given every time the pigs were fed. Those in lot 1

on dry feed drank more water than those in lot 2, including the water used in wetting the food. The pigs on wet food seemed to relish their food better than those on dry food and ate it much more rapidly.

The data for each pig are tabulated, dividing the time into three equal periods. The data secured at time of slaughtering are also tabulated and reproductions given of photographs of sections of the carcass of each pig. The following table summarizes the results:

Summary of comparison of wet and dry food for pigs.

	Weight July 1.	Weight Dec. 30.	Total gain in weight.	Average gain per day.	Total food consumed.	Cost of food per pound of gain.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Cents.*
Lot 1 (dry feed):						
Sow	57	304½	247½	1.35	2,115½	3.9
Barrow	68½	274	205½	1.12		
Lot 2 (wet feed):						
Sow	62½	318	255½	1.39	2,319½	3.6
Barrow	60	331	271	1.48		

The cost of food is based on shorts at $18 and bran at $14 per ton, oats at 30 cents and wheat at 45 cents per bushel.

There is a fraction of a cent in favor of the wet feed in the cost of producing 1 pound of gain. At the end of the first two months the difference in favor of the wet feed was much greater. As the feeding progressed this difference gradually became less on account of the increased amount of material eaten by the pigs fed on wet food. While there is not much in favor of the wet food, on the ground of economy as a whole, yet there was a marked increase in the growth and weight of the pigs in favor of this method. * * * There was a very large per cent of lean meat. The fat was lighter colored than that produced before, but further than this there were no special characteristics. * * *

By averaging the several periods we find that it required 4.64 pounds of food to make 1 pound of gain live weight in pen No. 1, or the dry-fed lot, and 4.46 pounds in pen No. 2, or those fed on wet food.

Both of the results are more encouraging than any we have reached before in our feeding experiments. They are such as to insure a profit in feeding grain to pigs at the present prices paid for pork and grain products.

VETERINARY SCIENCE AND PRACTICE.

J. F. Duggar, *Editor.*

Diseases of stock, R. R. Dinwiddie (*Arkansas Sta. Bul. No. 25, Dec., 1893, pp. 22*).—This is a popular discussion of blind staggers and colic, notes on the relation between cattle ticks and Texas fever, and a report on the general condition of live stock in the State. In December, 1890, two head of cattle were fed for six weeks on corn attacked by worms, mold, and smut. No bad effect was noticed. In January, 1892, a colt was fed for two weeks without injury on corn thoroughly molded. An old horse was fed for three weeks on shelled corn badly infested with

Penicillium glaucum, and later on bran artificially inoculated with the same fungus. In no case was any disease developed. Young cattle ticks from eggs deposited the previous fall were placed on a horse April 15.

The progeny of these ticks (grown on the horse), tested during the hot weather of summer on four cattle and in two successive generations, were found to have lost all power of producing the disease [southern cattle fever].

DAIRYING.

E. W. ALLEN, *Editor.*

Fat in milk as a practical basis for determining the value of milk for cheese-making, L. L. VAN SLYKE (*New York State Sta. Bul. No. 68, n. ser., Mar., 1894, pp. 205–248, figs. 7*).—This is part 5 of the series of bulletins on cheese-making. The extensive experiments on the manufacture of cheese carried on by the station for two years past "enable us, we believe, to demonstrate beyond reasonable doubt that fat in milk furnishes not only a fairer basis for judging the value of milk for cheese-making than the method now used, but that it furnishes the most accurate, practical basis, considered from all points of view, that has ever been proposed." In support of this the author cites data from the investigations above mentioned which were summarized in Bulletin No. 65 of the station (E. S. R., vol. v, p. 892). He shows that the loss of fat in cheese-making is quite independent of the fat in the milk, and that the yield of cheese should increase in proportion to the fat in the milk, being about 2.7 pounds of green cheese for each pound of fat in the milk, whether the milk is rich or poor in fat. The reasons which he gives for discarding the old system of paying for milk by weight are, that it is based upon the false assumption that all kinds of milk have the same cheese-producing value; that it is unjust; that it discourages the production of better milk and is a positive barrier to improvement; and that it encourages the addition of water, removal of cream, and similar forms of dishonesty. After demonstrating that the fat is a fair and just basis for paying for milk at cheese factories, the author gives directions for sampling and testing milk, and reprints a description of the Babcock test from Bulletin No. 36 of the Wisconsin Station (E. S. R., vol. v, p. 82).

The ripening of cream by artificial bacteria cultures, H. W. CONN (*Connecticut Storrs Sta. Bul. No. 12, Feb., 1894, pp. 20*).—The author makes some popular remarks on butter, sources of butter flavor, lack of uniformity in the flavor, and the effect of different bacteria on flavor, and describes experiments in ripening cream with pure cultures. In these experiments milk was taken each morning, creamed with a separator, and the cream then pasteurized. After cooling, the

cream was inoculated with the pure cultures, ripened from twenty-four to forty-eight hours, and churned.

The species of bacteria used were obtained by taking samples of ripened cream from several creameries in Connecticut and isolating the species of bacteria found in each. Each species was grown in a pure culture and tested separately.

With the different species of bacteria used there was a striking difference in the resulting ripened cream and butter. Sometimes the cream would be sour, sometimes sweet, sometimes its odor and taste would be pleasant, sometimes extremely bitter and disagreeable. The butter showed variations in color and grain, in the ease of washing, the ease of churning, in the odor and taste. The first point that may be mentioned is the fact that nearly all of the flavor of the butter appeared to be associated with the buttermilk rather than with the butter fat. This was no unexpected result. If the butter was tasted before it was washed, the peculiar flavor of the butter in question would be very prominent. If, however, it were washed with one or two washings of water, the flavor would be very much diminished and in some cases it would almost entirely disappear. The aroma is associated with products which are readily washed away from the butter, and a too complete washing is almost sure to result in a more or less tasteless product. It was found also that the use of salt made considerable difference in the flavor of the butter. In most cases the salt largely disguised the peculiar flavor and rendered many a poor lot of butter palatable. A disagreeable flavor may be disguised by the presence of salt, and the butter consequently pass as moderately good butter. In some cases, however, the use of salt seemed to enhance the aroma slightly, and at all events produced an aroma more nearly like that of ordinary butter.

It was found that each species of bacteria produced uniform results under uniform conditions. These species were used over and over again, and the experiments were repeated many times through a period of several months. A complete uniformity of results was obtained whenever the same species of bacteria was used for ripening under similar conditions. No matter how long the interval, the same flavor appeared in the butter. Species that were thus collected from cream in the fall of 1892 were retained in the laboratory for over a year and were used at intervals during this time, and at the close of the experiments the resulting butter was identical with that which arose in early experiments. From this it would appear that these species of bacteria remain constant in their properties for a year at least.

It was found that the temperature of ripening had a very great effect upon the results, but in a manner somewhat different from what might possibly have been supposed. Some species of bacteria used would ripen cream most readily at low temperature. Some of them grew very rapidly at a temperature of from 60° to 80° F., but if the temperature was raised above that, they produced no effect upon the cream. Others, again, produced their most prominent effect at quite high temperatures and produced very little effect at low temperatures, while in regard to other species still, the growth was about equal at any temperature from 60° up to 90° F. This is of importance in dairying, as the use of a proper temperature will eliminate the effect of certain species of bacteria. The use of such a temperature as 68° F., while it facilitates the growth of favorable species, will prevent the growth of many species which, at a higher temperature, would ruin the butter.

Among the many forms of bacteria liable to occur in milk and cream the majority produce butter which is neither especially good nor especially bad. A majority of our experiments produced butter which was described as "good, but too mild." * * *

Secondly, a small number of species of bacteria produced butter of a distinctly disagreeable aroma. * * *

A third class of species, consisting also of not a very large number, was found to give rise to an aroma of a high character, the butter being described as "excellent-

flavored and first-class." * * * Of the various species studied, the one producing the best results is one numbered 41, and obtained from a peculiar source. Among the food exhibits at the Columbian Fair was a lot of so-called "preserved milk" sent from Uruguay. It had become quite bitter, however, and from it my assistant obtained several species of bacteria. Of these one produced most excellent butter, proving in our experiments superior to any species obtained from other sources.

Practical experiments were made with this No. 41 at a creamery in the State. A gallon or two of the cream or buttermilk was set aside each day to be used as a starter for the next day's cream. At first the large vat of cream was pasteurized by heating to 155° F., but later this heating was omitted. "From the very outset an improvement in the quality of the butter of the creamery was noticed by all who examined it," and the improvement has remained constant.

Butter made from pasteurized and unpasteurized cream inoculated with this culture and from cream ripened in the ordinary way was exhibited at a recent meeting of the Connecticut Dairymen's Association and scored by a butter expert. The butter made from the pasteurized cream was slightly injured by the flavor of heated cream.

According to the expert, the use of an artificial culture of species 41 made a difference in the character of the butter equivalent to 14 points out of the 75 allotted to the flavor and grain, a difference of over 18 per cent. The butter made from the inoculated, unheated cream obtained a prize at the exhibit, while the normal butter fell below the prize limit.

Taking this experiment as the only test that we have at present, it will be seen that the use of artificial cultures appears to improve the character of butter, and to have produced in January a quality of butter closely resembling June butter.

Some observations on the working of the Cooley system and the DeLaval separator system in coöperative creameries (*Connecticut State Sta. Report for 1893, part III, pp. 145–170*).—The tests reported were made by members of the station staff at a creamery in the State.

Comparison of the churning of Cooley cream, separator cream, and a mixture of Cooley and separator cream (pp. 147–163).—The first trial was made with about 730 pounds of Cooley cream, some of which was frozen. In this trial 1.14 per cent of the total butter fat was lost in the buttermilk and washings. This loss is much higher than was found in any subsequent experiments, and it is believed that "there is little doubt that it is due to the fact that a portion of the cream had been frozen."

In the second trial of churning Cooley cream 411 pounds was used and there was a loss in buttermilk and washings amounting to 0.5 per cent of the total fat. The separator cream, 284 pounds, was ripened to the same degree of acidity as the last lot of Cooley cream (0.7 per cent of lactic acid) and churned. The loss in buttermilk and washings amounted to 0.7 per cent of the total fat. A mixture of 129½ pounds of separator cream and 226 pounds of Cooley cream was ripened and churned with a loss of 0.62 per cent of the total butter fat.

Omitting the first test with Cooley cream, the amount of fat lost in the buttermilk and washings for each 100 pounds of butter made was as follows:

Fat lost in buttermilk per 100 pounds of butter.

	Ounces of butter.	Money equivalent.*
		Cents.
Cream raised by the Cooley system	8.0	16
Cream raised by the separator system	11.5	23
Mixture of cream raised by the two systems	10.4	21

* Butter at 32 cents per pound.

In a further trial of this subject, using the milk of a herd of Guernseys and Jerseys, the loss of butter fat for each 100 pounds of butter made was as follows:

	Ounces.
Cooley cream	3.5
Separator cream	4.9
Mixed Cooley and separator cream	6.3

A comparison of the results by the two trials shows that there was in every case a larger loss of butter in the buttermilk from churning separator cream and mixed cream than from churning Cooley cream.

Comparison of the relative efficiency of the De Laval separator and the Cooley system for separating cream (pp. 163–170).—In connection with the above trials the opportunity was taken to test the efficiency of the separator and deep-setting on the same herd of cows. Ten such comparisons were made—four in May and six in November. Usually the morning's milk was creamed by one method and the evening's milk by the other. The temperature of the water in the Cooley creamer was between 40° and 45° F. In these trials the separator was found most efficient. The excess of loss by the Cooley system per 1,000 pounds of milk amounted to 0.37 pound of butter fat in May and 2.06 pounds of butter fat in November. In the test of May the quantity of fat left in the skim milk by the separator was so much larger than usual that it is suspected the separator was out of order or was not run at the proper speed. The scoring of the butter made from each kind of cream showed no marked difference which could be attributed to the method of raising the cream.

Waste of fat in skim milk by the deep-setting process, W. H. Jordan (*Maine Sta. Bul. No. 5, 2d ser., pp. 4*).—This is a study of the losses of fat in raising cream by deep-setting. A representative of the station accompanied the cream collectors of two butter factories and took samples of the skim milk from twenty-four hours' setting. These samples were treated with a preservative and sent to the station, where they were tested for fat. In all, 224 patrons were visited. Of these 221 raised the cream by deep-setting in shallow pans and 1 by means

of a separator; 194 kept ice constantly in the tanks. The visits were made during August, September, and October. The herds consisted mostly of grade Jerseys, although there were a number of Holstein herds.

One hundred and sixty-five of the 224 herds tested did not exceed 0.2 per cent of fat in the skimmed milk, the average being about 0.15 per cent. By the use of the separator on these farms not over 0.05 per cent fat would be saved, or 1 pound of butter fat to 2,000 pounds of skimmed milk, provided the deep-setting process is as successfully used all the time. It is not claimed that the work of the deep-setting process is always as good as this. The facts are stated simply as they are found. * * *

The above figures are certainly somewhat surprising. They are much more favorable to the cold deep-setting process than any heretofore published of which the writer is aware, and somewhat diminish the argument for the separator, in so far as it pertains to the prevention of waste in the skimmed milk.

A study in churning, H. C. WALLACE (*Iowa Sta. Bul. No. 22, pp. 819–832*).

Synopsis.—This is a study of the connection between the acidity of the cream and the loss of fat in the buttermilk, with detailed directions for making the acid test of cream. The acidity appeared to bear a decided relation to the loss of fat in churning and an acidity between 34 and 40* gave more favorable results than a lower or higher one.

It appears from the introduction that the loss of fat in churning in Iowa dairies and creameries is often excessively large.

In a number of cases we found the fat in the buttermilk to be above 4 per cent, and one sample tested as high as 7.2 per cent. The loss on the farm and in private dairies is much higher than in the creameries, although we have found as high as 2.5 per cent of fat in buttermilk from creameries; but this we believe to be exceptional. It is quite common, however, to find as much as 0.5 per cent of fat in the buttermilk from creameries.

The record is given for one day for a creamery in the State.

The amount of milk received was 10,492 pounds. In running this milk through the separator a total of 4.3 pounds of fat was lost in the skim milk, but in churning the cream the next day 29 pounds of fat was lost in the buttermilk. Considering this fat worth 20 cents per pound, which was about its value at that time, the loss in the buttermilk for the one day would be $5.80.

In 20 trials of churning at 56°, 120 gallons of cream ripened to an acidity of from 28.8 to 48.5,* the loss of fat in the buttermilk was lowest when the acidity was between 33 and 41. "When the acidity was between 38 and 41 it will be observed that the per cent of fat lost in the buttermilk was practically nothing." In 14 trials of churning at 54° from 50 to 180 gallons of cream ripened to from 30 to 42, "the recovery of the fat in the form of butter was practically complete at this temperature after the acidity reached 34 and upward. This indicates that when the cream is not ripe enough, a temperature of 54° is more favorable to complete recovery of the fat in churning than a temperature of 56°. * * *

*C. c. of acid required to neutralize 50 c. c. of cream.

"Concerning the amount of cream, we found in our work that within limits it had no appreciable effect on the loss of fat in the buttermilk. But when the churn was filled much more than half full the amount of fat lost was quite likely to be increased."

Some seventy other tests were made in which the acidity remained practically constant in different series, but the temperature was varied. The data for these trials show that with an acidity of from 34 to 40 the loss of fat was usually very slight, although the temperature varied from 52° to 60°. "In no case did we succeed in avoiding loss when the acidity was below 31; * * * in only two churnings was there complete recovery of the fat when the acidity was more than 42."

The composite sample at creameries, G. E. PATRICK (*Iowa Sta. Bul. No. 22, pp. 833–844*).—This is a discussion of the taking of samples proportionate to the amount of milk as compared with samples of uniform size, and of milk preservatives. The conclusion as to the method of sampling for composite samples is as follows:

Where a patron's deliveries run fairly uniform in amount from beginning to end of composite period, the usual method now in vogue [samples of uniform size] is nearly enough correct; but where a patron's deliveries show wide variation in amount, within the time of a composite period, the daily samples should unquestionably be taken proportionate in amount to the deliveries; then, however great the variations in richness, the composite will tell only the truth.

It was found that where 10 to 20 grains of potassium bichromate per 300 c. c. of milk was used for preserving the samples the result was satisfactory for about two weeks, after which a fermentation frequently set in, giving rise to a fruity odor and a destruction of the butter fat, often reducing the result of the test 0.3 or 0.4 per cent in a few days. When about one eighth of corrosive sublimate was mixed with the bichromate the preservation for one month or longer was perfect. Forty grains of the bichromate alone was not sufficient to preserve 300 c. c. of milk a month. Tests are reported with various mixtures of bichromate and corrosive sublimate. The conclusion from these is as follows:

The most efficient mixture yet found for preserving milk samples, and perhaps the best compound, all in all, for practical use at the creamery, is a mixture of potassium bichromate and mercuric chloride (corrosive sublimate), in the proportions of either 16 to 2 or 16 to 4, by weight. Of the mixture in proportions of 16 to 2, 15 to 25 grains suffice well for monthly composites; of the 16 to 4 mixture, 10 to 15 grains.

Rennet extracts of commerce, G. E. PATRICK (*Iowa Sta. Bul. No. 22, pp. 845–851*).—The author reports the results of examination of eight brands of rennet extract, each brand being tested from seven to ten times. The method of testing the curdling power is given. The study is said to be preliminary, and no trade names are given.

Among the rennet extracts examined there were found wide differences in composition and in coagulating power. * * *

As regards composition, organic solids range, in seven of the varieties examined, from 2.28 to 5.32 per cent, while in the eighth it reached 10 per cent in one sample and 18.75 in the other (verified by dulicate analyses).

Ash, mainly common salt, ranges from 10.45 to 19.75 per cent; and acidity, calculated as lactic acid, from 0.16 to 1.65 per cent.

AGRICULTURAL ENGINEERING.

Experimental work at Willcox, Arizona, F. A. GULLEY (*Arizona Sta. Bul. No. 10, Dec., 1893, pp. 11–16*).—This is a preliminary report on experiments by the Willcox Agricultural and Improvement Company, coöperating with the station, on the soils and underground water of the Sulphur Springs Valley in the southeastern part of Arizona, with "reference to determining the actual supply of available water, its quality, and cost of raising it to the surface for irrigation."

There seems no question as to the fertility of the soil or of its adaptability to the production of farm and garden crops and fruits for which the climate is suited. It would appear, therefore, to be a question of water supply to reclaim the valley.

The indications from this test so far are that there is sufficient available water in the underground flow to irrigate the greater part, if not the entire valley, and the main point at issue is the cost of raising the water to the surface by pumping. Can it be made profitable?

Pumping water for irrigation is becoming a matter of much interest, as there are many tracts of most excellent land too distant from flowing streams or lying too high to be reached from gravity canals, yet having abundant water from 15 to 50 feet below the surface of the ground. * * *

At the Willcox farm a centrifugal pump * * * and a ten-horse power engine and boiler have been used during the past summer. The capacity of the pump is 300 gallons of water per minute, 180,000 gallons in ten hours, or two thirds of a cubic foot per second.

Running up to its capacity, this pump, with boiler consuming 1 cord of wood in twenty-four hours, covers 1 acre of land 1½ feet deep, or 5½ acres with 3 inches of water, about the quantity used at this place at one irrigation.

With the average winter and summer rains at Willcox, it is believed that five to six such irrigations will be sufficient for the year for alfalfa, four for fruit trees, and two for corn, sorghum, and beans, with good cultivation.

On this basis and with this small pump and engine 1 cord of wood will pump water to irrigate 1 acre of alfalfa, 1½ acres of fruit trees, or 3 acres of the last-named crops.

Estimates furnished on the latest improved engines and pumps of ten times the capacity of this one show that 1 cord of wood or its equivalent may be made to pump water to supply four or five times as much ground.

"The perfection of the gasoline and kerosene engine will do much toward encouraging irrigation by pumping where fuel is scarce and expensive." The company has purchased a gasoline engine and a centrifugal pump which are guaranteed to supply 3,740,000 gallons of water in twenty-four hours, and will continue their investigations of the economy of pumping water for irrigation.

The value of Rio Grande water for the purpose of irrigation, A. GOSS and R. F. HARE (*New Mexico Sta. Bul. No. 12, Nov., 1893, pp. 33–58*).—Introductory remarks "explain the meaning of some of the terms used and briefly the relation of water, soil, alkali, and crops, from the chemical side of the question." Analyses of a sample of alkali from the Rio Grande Valley and of samples of water from the Rio Grande River taken at 9 different dates between June 1 and October

31 and of the sediments at 7 of these dates are tabulated and discussed.

The results, as the following summary will show, indicate that "Rio Grande water ranks high for irrigating purposes."

Owing to the continual presence of gypsum in the water, alkali deposited from the Rio Grande must be of the white variety, which is much less injurious than the black kind. This fact also makes the river water an excellent antidote for black alkali. * * *

If possible, the river water should not be used for irrigating immediately following a rise due to heavy rains coming after a protracted dry period, as it contains more alkali under those conditions. The water characterized by a large amount of a brick-red sediment and locally known as *rio puerco* water, should not be used, if possible, as this water contained a larger amount of alkali than that of any other period examined.

More plant food is probably added to the land by using 2 feet in depth of the river water per annum in irrigating than is removed by crops, hence by using that amount of water such a thing as the absolute exhaustion of the land is probably impossible. By far the greater amount of the plant food exists in the sediment, hence in irrigating it is desirable to get as much sediment on the land as possible. Assuming that the average for the year would be about the same as that obtained for the five months determined, about 81,309 pounds of sediment would be added to each acre in one year by using 2 feet of water. This would make a uniform layer about a quarter of an inch thick and would contain 1,821 pounds of potassium sulphate, 116 pounds of phosphoric acid, and 107 pounds of nitrogen. In addition to this, about 90 pounds of potash would be supplied by the water itself.

STATION STATISTICS.

Summary of Annual Report of Connecticut Storrs Station for 1892 (*Connecticut Storrs Sta. Bul. No. 11, Apr., 1893, pp. 10*).—This is a reprint from the annual report of the station for 1892 (E. S. R., vol. v, p. 607) on nitrogen assimilation, fertilizer experiments, bacteria in the dairy, and studies on human food.

Report of treasurer of Oklahoma Station (*Oklahoma Sta. Bul. No. 9, Jan., 1894, p. 38*).—This is for the fiscal year ending June 30, 1893.

Summary of Annual Report of Vermont Station for 1892 (*Vermont Sta. Buls. Nos. 37, 38, and 39, pp. 3 each*).—These are also designated as Newspaper Bulletins Nos. 10, 11, and 12, and consist of reprints from the Annual Report of the station for 1892 (E. S. R., vol. v, p. 325).

ABSTRACT OF PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE.

Some destructive potato diseases, B. T. GALLOWAY (*Division of Vegetable Pathology, Farmers' Bul. No. 15, pp. 8, figs. 8*).—Brief popular descriptions are given, with suggested methods for the prevention, of the potato blight (*Phytophthora infestans*), Macrosporium disease (*Macrosporium solani*), and potato scab. The use of Bordeaux mixture is recommended for the first two diseases, and soaking the tubers in a weak solution of corrosive sublimate before planting is advised for the prevention of the potato scab.

Monthly Weather Review (*Weather Bureau, Monthly Weather Review, vol. XXI, Nos. 7–12, July–Dec., 1893, pp. 179–376, charts 36*).—These numbers are devoted exclusively to the usual meteorological topics, except the August number, which contains in addition reports of the proceedings of the Meteorological Congress at Chicago, August 21–24, 1893, and of the second annual convention of the American Association of State Weather Services.

Experiments with sugar beets in 1893, H. W. WILEY and W. MAXWELL (*Division of Chemistry, Bul. No. 39, pp. 59*).—The following are the most important topics treated: Distribution of sugar-beet seed; analysis of 283 samples of beets grown in 17 States and Territories; sugar-beet statistics; relation of irrigation to sugar-beet culture; method of storing beets; effect of storage on weight and sugar content of beets; method of caring for mother beets; yield, value, and cost of producing beet seed; meteorological conditions of the growing season; and a comparison of the relative values of home-grown and imported beet seed.

In 1893, 43,953,264 pounds of beet sugar were made in the United States. The total number of tons of beets used during the year was 200,000, for which the farmers received an average price of $4.50 per ton, or a total of $900,000. The sugar produced was valued at $1,320,000, which amount was increased by means of the bounty to $2,180,000, the total amount of money received for the beet sugar produced in 1893.

The experiments discussed in this bulletin were made at Schuyler, Nebraska. The average sugar content of the beets produced in 1893 at

this station was at harvest (October 10), 15.1 per cent; at the time of their storage in silos with ice, November 4, 12 per cent; and at the opening in the spring, 11.6 per cent. The stored beets kept satisfactorily and gained 11.5 per cent in weight.

Beet seed was produced at the rate of 863 pounds per acre and sold for $172.60 per acre. Beets were grown both from imported and from home-grown seed. The average for three varieties of home-grown seed was 5,891 pounds of sugar per acre, and the average for imported seed of the same varieties was 5,185 pounds, or a gain of 706 pounds, or 12 per cent in favor of home-grown seed. Home-grown seed germinated more quickly and showed a greater vitality than the imported seed.

Irrigated beets averaged 16.2 tons per acre, containing 15.3 per cent of sugar, or 4,954 pounds of sugar per acre; while beets not irrigated yielded 13.4 tons per acre, containing 4,238 pounds of sugar. Irrigation, therefore, increased the yield of sugar about 700 pounds per acre. The increased yield of sugar beets was effected without any appreciable decrease in the sugar content.

Beets planted in May averaged 5,538 pounds of sugar per acre, and those planted in June 4,128 pounds.

Special experiments conducted during the seasons of 1891, 1892, and 1893, were devoted to the study of influences causing loss of weight and sugar in the beet and to modes of preventing such loss. It has been found that high temperature and direct sunlight are the main causes of the decomposition of sugar in the organism, and that storing at low temperature prevents such decomposition. Moreover, the experiments of this season have indicated that excess of moisture is not an immediate cause of depreciation of quality in the beet, and that, under given conditions, submersion of the beets in water for a limited length of time may be found an excellent mode of preservation.

Report of the statistician (*Division of Statistics, Report No. 113, n. ser., Mar., 1894, pp. 156*).—The report includes statistics and information on the distribution and consumption of corn and wheat, the supply and distribution of wheat for twenty-five years, the wheat crop of the world, wholesale prices of principal agricultural products in all sections of the United States, expense of raising wheat and corn, production of honey and beeswax, poultry and eggs, dairy products, official statistics of foreign crops, world's wool supply, notes from U. S. consular officers and European agents, and domestic and transatlantic freight rates.

Concerning the cost of raising wheat and corn, tabulated estimates are given of over 2,500 practical farmers in the case of wheat and over 2,800 in the case of corn. The tables show the estimated cost in different States and groups of States. The following summary gives the estimates by groups of States, and the average for the whole country, taking into account the area under cultivation.

Estimated cost of production per acre of wheat and corn by sections for 1893.

	Wheat.							Corn.						
	New England States.	Middle States.	Southern States.	Western States.	Mountain region.	Pacific States.	General average.	New England States.	Middle States.	Southern States.	Western States.	Mountain region.	Pacific States.	General average.
Rent of land	$3.52	$4.01	$2.79	$2.62	$3.88	$3.31	$2.81	$4.78	$4.17	$3.00	$2.98	$2.61	$4.50	$3.03
Manure	4.41	5.16	2.09	1.85	2.70	2.62	2.16	4.69	5.99	1.89	1.62	2.58	4.14	1.86
Preparing ground	3.32	2.79	1.71	1.80	2.29	2.02	1.87	4.21	2.95	1.52	1.59	2.01	2.53	1.62
Seed	2.16	1.40	0.93	0.92	0.95	1.03	0.96	.....	.....	.....	.....	.....	.....	.....
Planting	.....	.....	.....	.....	.....	.....	.....	1.51	0.74	0.53	0.34	0.52	0.68	0.42
Sowing	0.52	0.48	0.41	0.36	0.37	0.32	0.37	.....	.....	.....	.....	.....	.....	.....
Cultivating	.....	.....	.....	.....	.....	.....	.....	3.50	2.50	2.24	1.53	1.50	1.98	1.80
Harvesting	2.27	1.40	0.94	1.18	1.78	1.41	1.19	.....	.....	.....	.....	.....	.....	.....
Gathering	.....	.....	.....	.....	.....	.....	.....	4.77	2.70	0.80	1.35	1.64	1.98	1.22
Thrashing	2.02	1.43	0.95	1.18	1.66	1.41	1.20	.....	.....	.....	.....	.....	.....	.....
Housing	0.73	0.63	0.33	0.32	0.58	0.55	0.37	2.13	0.99	0.52	0.45	0.84	0.73	0.50
Marketing	1.27	0.88	0.79	0.66	1.59	1.31	0.76	2.46	1.49	1.31	1.22	1.59	1.82	1.26
Total cost	20.22	18.18	10.94	10.89	15.80	13.98	11.69	28.03	21.53	11.81	11.08	13.29	18.36	11.71

In the statistician's report for December, 1893, the average farm value of wheat and corn produced per acre was stated as follows: Wheat, $6.16; corn, $8.21. This would show on the face of it a virtual loss to the farmer of $5.53 per acre of wheat and $3.50 per acre of corn for the year 1893. It must be remembered, however, that besides the production of the grain the farmer has the straw of the wheat and the stalks of corn, which have in some sections of the country a feeding value of about $5 per acre, and that while the cost of production was about normal, the price per bushel of wheat was unprecedentedly low and that of corn much below the average. * * *

With wheat selling at 57 cents and corn at 36 cents a bushel in Chicago, it is impossible to escape the conclusion that a rotation of crops rather than a persistence in exclusive wheat-growing would be more profitable to our farmers.

Organization lists of the agricultural experiment stations and agricultural schools and colleges in the United States (*Office of Experiment Stations, Bul. No. 19, Jan., 1894, pp. 99*).—This includes a list of the experiment stations in the United States, the governing boards and station staffs, a list of agricultural schools and colleges in the United States, with courses of study and boards of instruction, officers of the Association of American Agricultural Colleges and Experiment Stations, officers and reporters of the Association of Official Agricultural Chemists of the United States, list of station publications received during 1892 and 1893, federal legislation affecting agricultural colleges and experiment stations, regulations of the Post Office Department regarding experiment station publications, rulings of the Treasury Department as to the construction of the act of Congress establishing agricultural experiment stations, and an index of the names of college and station officers.

Proceedings of the Minnesota Good Roads Convention (*Office of Road Inquiry, Bul. No. 2, pp. 16*).—This is a condensed report of the proceedings of the first annual meeting of the Minnesota Good Roads Convention, held at St. Paul, Minn., January 25 and 26, 1894.

Improvement of the road system of Georgia, O. H. SHEFFIELD (*Office of Road Inquiry, Bul. No. 3, pp. 31*).—After showing that the present system of road working in Georgia "is a failure and a disgrace to civilization, that commerce demands a change, [and] that better roads are the great and growing need of the State," the principles underlying the construction of good roads are discussed and a scheme proposed for maintaining the roads of the State. The author advocates the use of convict labor where practicable.

There are now in this State, in round numbers, 1,900 male penitentiary convicts, the lease of whom yields to the State a yearly income of $25,000. There are probably at least 600 more chain-gang convicts, yielding a small income to the individual counties. It would not, then, be an exaggerated statement to say that there are 2,400 convicts, all told, that would be available for road work. This will be an ample force for the requirements, since it would give about 50 for each 3,000 of road population.

To maintain the roads for a given district he estimates that the cost under the present system is $10,000; that under the paid labor system it would be $7,500; and under the convict system, paying the same rate as now received for convicts by the State, $5,250. "To do the present work [employing paid labor] a direct tax of $1.50 and an ad valorem of one tenth of 1 per cent is sufficient. * * * By employing convict abor the above rate would be materially decreased."

ABSTRACTS OF REPORTS OF FOREIGN INVESTIGATIONS.

Studies on casein, A. BÉCHAMP (*Bul. Soc. Chim. Paris, 11 (ser. 3), pp. 152–176*).—The author describes his interesting studies on the nature and properties of the casein of milk. He finds that casein is not a soluble substance which may be coagulated by acids, but that on the contrary it is an insoluble substance forming soluble compounds (caseinates) with alkalies and lime, and that the insoluble casein may be precipitated from these compounds by acids which combine with the bases of the caseinates. Neither is casein coagulated by the action of heat, although the lactalbumen and galactazmase accompanying casein in milk are coagulated by heat. Hence the casein precipitate obtained by heating milk with an acid will contain coagulated lactalbumen and galactazmase as impurities. The preparation of pure casein is described by the author as follows: Perfectly fresh milk is cooled and the exact amount of acetic acid added which is necessary to saturate the bases, usually about 2.9 c. c. of glacial acetic acid per liter of milk. The precipitate is washed on a filter, mixed with twice as much water as there was milk taken, and then a solution of pure sesquicarbonate of ammonia added to slight alkalinity to dissolve the casein. After filtering the casein is reprecipitated with acetic acid, as before, and this is repeated four times. This gives a pure casein which leaves no ash when incinerated.

The pure casein freed from every trace of acetic acid by washing is somewhat soluble in water, and its aqueous solution reddens litmus paper much the same as carbonic acid. When the mixture of casein and water is heated on a water bath it appears to melt, and a sort of gelatinous mass is formed which solidifies on cooling and is soluble in water and in ammonium carbonate. As the dry casein does not melt when heated, the author suggests that this apparent melting with water may be due to the formation of a hydrate. The rotary power of the pure casein and the caseinates is given.

Casein is completely dried by heating at 140° C., and suffers no change at this temperature. Above this temperature it is gradually decomposed, the substance resulting being insoluble in water or ammonium carbonate.

Casein has a weak but positive acid reaction towards litmus, and can form caseinates with alkalies. The author is confident that the acid

reaction comes from the casein itself, and is not due to a trace of acetic, acid in the preparation. The caseinates of alkalies and alkaline earths are less soluble in the heat than at ordinary temperature. They are precipitated with common salt. Carbonic acid does not precipitate casein or the caseinates. Dilute hydrochloric acid readily dissolves casein, but the addition of concentrated hydrochloric acid to such a solution gives a precipitate containing from 9 to 12 per cent of hydrochloric acid. Casein can take up 34 per cent of acetic acid, forming a solid body which, when dried over lime in a vacuum, contains about 24.5 per cent of acetic acid, but has no odor of acetic acid. The ash-free casein was found to contain both phosphorus and sulphur. The average was 0.752 per cent of phosphorus and 0.043 per cent of sulphur.—E. W. A.

Determination of available phosphoric acid in manures, B. DYER (*Jour. Chem. Soc., London, 1894, Mar., pp. 162–167*).—Incidental to an investigation of the available phosphoric acid and potash in the soil (p. 1013) the available phosphoric acid in a large number of different phosphatic materials (mineral phosphates, bone, slag, guano, etc.) was determined by the following methods:

"Two hundred cubic centimeters of ammonium citrate solution rendered distinctly ammoniacal were shaken up with 2 grams of the manure or material to be tested in a stoppered bottle and allowed to stand, with occasional shaking, for three days at a temperature of 10° to 18° C., * * * or 0.5 to 1 gram of the manure or material was placed in a bottle with 200 c. c. of 1 per cent citric acid solution and allowed to stand, with occasional shaking, for three days."

The reverted phosphoric acid was determined directly in the solution thus obtained by the following method: "The solution was evaporated to dryness in a platinum basin and gently incinerated at a low temperature. The residue was dissolved in pure hydrochloric acid, evaporated to dryness, redissolved, and filtered." In the filtrate the phosphoric acid was determined by Hehner's method.

The conclusions were reached that a 1 per cent citric acid solution appears to give indications fairly bearing out the manurial properties of phosphatic materials as recognized by experience in the field, and that "the use of ammonium citrate (the reagent ordinarily employed as a means of diagnosing the condition of insoluble phosphates) being clearly based upon wrong principles should be abandoned, and the method of Tollens and Stutzer adopted."

Warington, in a discussion of Dyer's paper,* suggested that a mixture of citric acid and a citrate as proposed by Wagner (10 grams of the former and 150 grams of the latter, diluted to one fifth when used) promised in the light of the results reported to give more accurate results than the citric acid solution, in the study both of soils and phosphatic fertilizers. He pointed out that the results reported showed that the

*Chem. News, 69 (1894), No. 1789, pp. 113, 114.

action of the acid solution on the soil did not always correspond to that of the barley roots, and that in the examination of certian phosphates the acid solution was fully as unreliable as the ammonium citrate solution.—W. H. B.

Assimilation of the gaseous nitrogen of the air by microbes, S. WINOGRADSKY (*Compt. Rend., 118 (1894), No. 7, pp. 353–355*).—In a previous article* the author has shown that there is little difficulty in isolating the microörganisms which fix nitrogen in the soil by the use of cultures deprived of combined nitrogen.

By simple processes of purification a mixture of only three bacilli was obtained. Of these three, which were evidently adapted to life in a medium very poor in nitrogen, only one appeared to be endowed with the function of assimilating gaseous nitrogen.

Before discussing the pure cultures of this organism, three series of experiments with impure cultures are reported. These experiments were made in Erlenmeyer flasks in which the depth of culture liquid did not exceed 8 or 9 mm. The composition of the liquid was in all cases the same, except that the quantities of dextrose and of combined nitrogen in the form of sulphate of ammonia varied. There was always a slight excess of carbonate of lime.

The first of these series of experiments showed that in a medium free from nitrogen or containing only traces of that substance the gain of nitrogen was approximately proportional to the quantity of dextrose decomposed. In the first two experiments of this series in which the conditions were normal the gain of nitrogen was 2.5 to 3 parts per thousand of dextrose; in the second two in which the culture medium was less thoroughly aërated the gain was only 2 to 2.5 parts; while in the third two, in which the conditions were still further modified, the gain fell to 1.5 parts.

In the second and third series of experiments, in which variable amounts of sulphate of ammonia as well as of dextrose were used, the results show that the gain in nitrogen depended upon the relative proportions of combined nitrogen and of dextrose, no appreciable gain of nitrogen being produced with less than 6 parts of sulphate of ammonia to 1,000 parts of dextrose.

For isolating the bacillus which fixes the free nitrogen the anaërobic culture method of E. Roux in hermetically sealed tubes on slices of carrot was used with good results. This method of experimentation, which appeared contradictory to the fact that the bacillus had grown during six months in a well aërated liquid was suggested by the following considerations: (1) The bacillus is a typical butyric ferment, and (2) in the conditions of impure cultures it might have been preserved from the oxygen of the air by the aërobic organisms with which it was associated.

When inoculated in a state of purity in the sugar solution and

*Compt. Rend., June 12, 1893.

exposed to the air in thin layers the bacillus refused to grow. All the cultures remained sterile indefinitely, but as soon as the other two bacilli or certain of the common molds were introduced the fermentation and growth of the bacillus commenced. It appears that this is a universal characteristic of this bacillus, which is widely distributed in the soil, and sheds a new light on the causes of the germination of true anaërobes in a medium so thoroughly aërated as the soil.

The anaërobic character of the bacillus was demonstrated, however, by the fact that it fermented dextrose in the absence of air, provided a small amount of ammoniacal nitrogen was added.

The condition which promotes the fixation of gaseous nitrogen by this microbe in a state of purity is a thin layer of a sugar solution free from combined nitrogen in contact with an atmosphere of pure nitrogen. Growth and fermentation under these conditions are very active. Two experiments each with 20 grams of dextrose and without nitrogen showed gains of 24.7 and 28 mg. of nitrogen, respectively.

This bacillus does not grow in bouillon or gelatin. The principal products of fermentation of the dextrose are butyric acid, acetic acid, carbonic acid, and hydrogen. The gas evolved during fermentation is very rich in hydrogen, containing sometimes as much as 70 per cent.

It is believed that the fixation of gaseous nitrogen is brought about by the contact of the nitrogen with nascent hydrogen in the presence of living protoplasm, resulting in the synthesis of ammonia as an immediate result.—W. H. B.

Influence of arsenic on plants, E. LYTTKENS (*Tidskr. Landtmän, 15 (1894), p. 172*).—On examining a large number of superphosphates 40 per cent were found to contain arsenic in appreciable quantities, owing to the application of arsenious materials in the manufacture of the sulphuric acid. Experiments were therefore undertaken to study the effect of arsenic in the ground on plants. Nobbe has demonstrated that plants grown in water cultures are very sensitive to even minute quantities of arsenic and are greatly injured by it. The author's experiments showed plainly that arsenic in the ground is also a strong poison to plants. The study of the subject is being continued at the Halmstead Experiment Station (Sweden).—F. W. W.

Symbiosis between Heterodera radicicola and cultivated plants in the Sahara, P. VUILLEMIN and E. LEGRAIN (*Compt. Rend., 118 (1894), No. 10, pp. 549–551*).—The authors mention the occurrence of the nematode *Heterodera radicicola* upon the roots of most of the garden plants growing at El Oued in southeastern Algeria. Carrots, turnips, onions, beets, eggplants, celery, tomatoes, etc., were all affected and showed upon their roots a varying number of swellings caused by the action of nematodes. In the case of beets, eggplants, and celery the swellings appeared only after transplanting. The plants did not seem to suffer from the parasitism, but, on the contrary, those not developing swellings showed a stunted growth and failed to mature.

The presence of nematodes in the soil denotes a sufficient amount of water in the soil to enable plants to make some growth in nearly arid regions. A histological examination of the enlargements showed a very advantageous modification of the tissues caused by the irritation of the parasites, permitting a true symbiosis between the *Heterodera* and the plants. About the nematodes were developed numerous vessels of both primary and secondary tissue which had been transformed into swollen bladders. The protoplasm, rich in nitrogen and poor in starch, imprisoned within the cell walls large quantities of water. The cell walls become thickened, lose their character as collenchyma and become small water reservoirs. Through a great number of punctures the utricles are permitted to take the water and distribute it to other cells lying near.

The garden at El Oued was composed of a very sandy soil which absorbed twice a day a great quantity of water. Through the intervention of the structures induced by the parasites a sufficient quantity of water is held in reserve to protect the plants during the intervals between the periods of irrigation. The transformation of vessels and larger cells was noticed in the beet, celery, eggplant, and tomato. In the case of the onion the nematode confined itself to the outer layers of the root, avoiding the central cylinder. In the case of turnips and carrots the vessels are formed much in the same way but soon disappear and their places are taken by vessels which are not transformed and by parenchyma. By these means turnips and carrots are better able to withstand drought and this modification is evidently brought about by the attacks of the nematodes.

The tubercles ordinarily formed by the lower organisms upon the roots of legumes were not found at this place, but a little distance away on the northern shore of Lake Melrir the author observed the tubercles on the roots of Medicago. Their ability to resist drought and their symbiotic influence on vegetables where cryptogamic symbiosis is precluded, in the authors' opinions make nematodes of great benefit here, instead of being the destructive agents they are usually considered.—W. H. E.

Influence of salts of potassium on nitrification, J. Dumont and J. Crochetelle (*Compt. Rend., 118 (1894), No. 11, pp. 604–606*).—In a former paper* the authors called attention to the beneficial influence which potash salts exerted on soils rich in humus and lime. In the present article experiments on moor soil containing 185 grams of humus and only 2.85 grams of lime per kilogram of soil are reported. The soil samples were kept in an oven at a constant temperature of 25° C., and maintained in a proper state of moisture by frequent watering. Carbonate of potash at rates of 0.1 to 6 per cent and sulphate of potash at rates of 0.5 to 5 per cent were applied in solutions to the soil. After twenty days the soils were leached and the nitric nitrogen per 1,000

* Compt. Rend., 117 (1893), No. 20, pp. 670–673 (E. S. R., vol. v, p. 903).

grams of soil determined. The results show that the carbonate of potash promoted nitrification, even when used at rates of 4 to 6 per cent of the soil.

The sulphate of potash was ineffective in the present case, although in former experiments on humus-calcareous soils it had given extraordinary results, even when applied in large doses. Apparently this result was due to the fact that the moor soil used was comparatively poor in lime. This fact was verified by a new series of experiments in which a mixture of sulphate of potash and carbonate of lime was applied. The lime renders the sulphate of potash effective by transforming it into carbonate. It was observed that the leachings obtained from soils to which sulphate of potassium had been added were colorless, while those to which a mixture of sulphate of potassium and lime had been added were highly colored. This is due to a solution of the organic matter in the carbonate. The drainage water also showed the presence of considerable amounts of sulphate of lime.

These experiments show in general that gardeners who use soils very rich in humus can very materially promote nitrification by adding unleached ashes or sulphate of potassium, provided that in the latter case, if the soil is relatively poor in lime, a previous application of lime is made. Since it is not possible in practice to apply the excessive amounts of these salts which were used in these experiments, it is urged that the facts demonstrated in these investigations should be applied in the preparation of composts to be subsequently used on the soils under cultivation.—W. H. B.

The inoculation of clay soil for lupines, A. SCHMITTER (*Inaugural Dissertation, Heidelberg; abs. in Bot. Centbl., 57 (1894), No. 1, pp. 25, 26*).—When cultivated clay soil was inoculated with earth containing bacteria from the root tubercles of lupines only negative results were secured. When, however, soil previously uncultivated was inoculated in the same way, the increase in the weight of lupine plants in the inoculated soil ranged between 11 and 32 per cent. The difference in the growth on inoculated and uninoculated soil was here apparent to the eye.

Soil inoculation was especially advantageous on sterilized soil. Here the tubercles on the inoculated area weighed about 100 times as much as on the areas not inoculated. These results have a practical bearing for new ground only.—J. F. D.

The analytical determination of probably available "mineral" plant food in soils, B. DYER (*Jour. Chem. Soc., London, 1894, Mar., pp. 115–167; and Chem. News, 69 (1894), No. 1789, pp. 113, 114*).—After brief introductory remarks on soil analysis in general, the author gives short notices of the more important papers hitherto published on the study of the availability of plant food in the soil.

To decide upon the solvent which was most likely to give an accurate measure of the phosphoric acid and potash available to plants in

the soil, determinations were made of the average acidity of the root sap of about 100 plants, belonging to 20 natural orders, to find out if possible the strength of the natural solvent which plants have at their command. The methods pursued and the results obtained in the investigation are given in detail. The acidity in the case of different orders of plants varied from 0.34 per cent (calculated as citric acid) in *Solanaceæ* (potato) to 3.4 per cent in *Rosaceæ*, and averaged 0.91 per cent for the 20 orders. The results were thought to indicate that the 1 per cent citric acid solution proposed by Tollens and Stutzer for the determination of reverted phosphoric acid in manures would probably meet the required conditions, and it was decided to test it on soils of known history and recorded fertility.*

For this purpose 22 plats of the experimental barley field at Rothamsted were sampled, and the samples subjected to separate investigation, including careful determinations of the total potash and phosphoric acid and of that soluble in strong hydrochloric acid and in 1 per cent citric acid solution. The method used in determining citric-acid soluble potash and phosphoric acid was as follows:

"A weight of air-dry soil, corresponding to 200 grams of completely dried soil, was placed in a bottle with 2 liters of distilled water, in which was dissolved 20 grams of pure citric acid. The soil was allowed to remain in contact with the 1 per cent citric acid solution for seven days, being, except on one day, shaken up a great many times each day, *i. e.*, whenever the soil had settled well down. The bottles rested, however, at night. Altogether the shaking up of the soil, which was not violent, but only sufficient to break up the cake of mud which formed each day, may have been performed on each sample about 400 times. The temperature ranged between 10° and 19° C. and averaged about 15° C. The experiments being made in winter, it was practically impossible to keep a constant temperature in the laboratory, and the bottles were too large and too numerous to be placed in any ordinary constant temperature closet. On the whole the conditions throughout the 22 experiments may be said to have been fairly even.

"After seven days' treatment as above the solutions were filtered. Five hundred cubic centimeters, that is, the solutions from 50 grams of soil, was used for each determination. In each case the solution was evaporated to dryness in a platinum basin and gently incinerated at a low temperature. The residue was dissolved in pure hydrochloric acid, evaporated to dryness, redissolved, and filtered. In the filtrate the phosphoric acid or potash, as the case might be, was determined by Hehner and Tatlock methods, and as the actual precipitate weighed represented 50 grams of soil, multiplication of any experimental error in converting into percentages was minimized."

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*For method used by Maercker for this purpose, see E. S. R., vol. v, p. 471.

The history of the plats, the methods used, and the results obtained are given in detail, with full discussion. The general conclusion was reached that the use of the citric acid solution gives valuable indications of the available fertility of soils such as are not obtained in ordinary soil analysis, and the results suggest that, when a soil is found to contain as little as about 0.01 per cent of phosphoric acid soluble in a 1 per cent solution of citric acid, it would be justifiable to assume that it stands in immediate need of phosphatic manure. The potash supply of soils appears to be more complicated than that of phosphoric acid and needs further investigation. The results in the present case indicate that the limit "marking the nonnecessity of special potash applications" probably lies below 0.005 per cent of citric-acid-soluble potash.

"Appended to the account of the work on soils is an account of some experiments on phosphatic manurial materials, comparing the solvent action of alkaline ammonium citrate and dilute citric acid, the result of which is to confirm the views of Tollens and Stutzer, to the effect that, although ammonium citrate may suffice to dissolve 'reverted' or 'retrograde' phosphate, it does not suffice to indicate 'available' phosphate, and that its use ought to be superseded by that of a weak solution of citric acid."

In the notice of the article published in *Chemical News*, an account of the discussion of the paper by Sir J. Henry Gilbert, R. Warington, and others is given.—W. H. B.

The physiological value of soil-soluble phosphoric acid, J. Stocklasa (*Mitt. Ver. Förd. landw. Versuchw. Oesterr., 1893, No. 8, part II, pp. 140–146*).—The water-soluble portion of superphosphates consists of orthophosphoric acid, monocalcium phosphate, monomagnesium phosphate, monoferric phosphate, and monoaluminum phosphate. Of these the orthophosphoric acid and monocalcium phosphate largely predominate in ordinary superphosphates. These substances undergo various changes when brought into contact with the sulphates, carbonates, and silicates of iron and alumina by which their solubility is impaired. It is an error, however, to class the aluminum salts with the iron salts in this respect, since aluminum sulphate, the form most common in superphosphates, does not form insoluble compounds with orthophosphoric acid and monocalcium phosphate, although aluminum silicate does form an insoluble compound with the latter substance. The author's investigations have shown that the water-soluble phosphoric acid of superphosphates is changed by the action of the aluminum and ferrous and ferric salts of the soil into "mono-di-ferric phosphate," $Fe_2O_3(P_2O_5)_2.8H_2O$, "mono-di-aluminum phosphate," $Al_2O_3(P_2O_5)_2.8H_2O$ (formed by action of aluminum silicate), and "di-tri-ferric phosphate" $(Fe_2O_3)_4(P_2O_5)_5.3H_2O$.

These salts were prepared in quantity and applied, with monocalcium phosphate and orthophosphoric acid in amounts furnishing 50 and 100 kg. of phosphoric acid per hectare, both with and without sulphate of

potash (at the rate of 40 kg. of potash per hectare) and nitrate of soda (in amounts furnishing 48 and 100 kg. of nitrogen per hectare), on three series of duplicate plats of soil of known composition planted to sugar beets.

The yield and sugar content of the crop produced in each case is tabulated, the yield of sugar per hectare being calculated.

It appears that where nitrogen and potash were not applied, monocalcium phosphate, orthophosphoric acid, mono-di-ferric phosphate, and mono-di-aluminum phosphate gave better results both as regards quantity and quality than di-tri-ferric phosphate. An application of 100 kg. of phosphoric acid in the form of monocalcium phosphate alone per hectare reduced the yield. An application of 100 kg. of phosphoric acid in the form of mono-di-ferric phosphate and mono-di-aluminum phosphate gave the same results as an application of 50 kg. of phosphoric acid in the same forms.

Where nitrate of soda and sulphate of potash were used there was a wide difference between results produced by monocalcium phosphate and orthophosphoric acid. The previous observation of the author that monocalcium phosphate gives better results on soils deficient in lime than orthophosphoric acid was confirmed in these experiments. Orthophosphoric acid is much more readily transformed into insoluble compounds by aluminum and ferrous and ferric salts in the soil than monocalcium phosphate. The best proof of this is that in these experiments orthophosphoric acid gave the same result as mono-di-aluminum phosphate and mono-di-ferric phosphate. This result confirms the author's statement that the water-soluble phosphoric acid in the soil after a certain time is changed into these insoluble combinations.

By using 100 kg. of phosphoric acid in the form of monocalcium phosphate and 48 kg. of nitrogen in the form of nitrate of soda the yield was not affected, but the quality of the beets was improved. With applications of 100 kg. of phosphoric acid in the form of mono-di-aluminum phosphate, mono di-ferric phosphate, and di-tri-ferric phosphate under the same conditions the yield was the same as with 50 kg. of phosphoric acid.

With applications of 100 kg. of nitrogen in the form of nitrate of soda the monocalcium phosphate increased the yield of sugar beets; with the di-tri-ferric phosphate it increased the yield also, but did so at the expense of the sugar content. This may be explained as follows: Although the phosphoric acid was present in double quantity the plant was rendered incapable of taking up the necessary phosphoric acid on account of paralysis of the root hairs due to the abnormal amount of nitrate of soda in the soil, and as a consequence the beets grew rapidly at the expense of the sugar content. The practical deduction from these experiments is that while an application of 48 kg. of nitrogen in the form of nitrate of soda is beneficial, larger applications may be injurious.

In combination with nitrate of soda the mono-di-aluminum phosphate was easily assimilable and gave practically the same results as the orthophosphoric acid. The mono-di-ferric phosphate stands next, and the di-tri-ferric phosphate last. In combination with 100 kg. of nitrogen in the form of nitrate of soda the phosphates used gave the following results:

	Kilograms of sugar per hectare.
Monocalcium phosphate	6,450
Mono-di-aluminum phosphate	6,040
Orthophosphoric acid	6,015
Mono-di-ferric phosphate	5,538
Di-tri-ferric phosphate	3,537

—W. H. B.

On the starch content of Norwegian potatoes, J. SEBELIEN (*Norsk Landmansblad, 13 (1894), pp. 68–70*).—The starch was determined in 122 samples of potatoes grown on 85 farms in different parts of Norway. The following summary shows the results of the examination:

Under 13.90 per cent starch, 20 samples = 16.4 per cent of total number.
Under 14.15 per cent starch, 22 samples = 18 per cent of total number.
Under $15\frac{1}{17}$ per cent starch, 38 samples = 31.1 per cent of total number.
Over 17 per cent starch, 42 samples = 34.4 per cent of total number.
Highest per cent found, 20.59.

Thirty-nine samples, or 32 per cent of the total number examined, were Magnum bonum potatoes; only 3 samples of this variety contained less than 13.9 per cent of starch, and 31 samples contained over 15 per cent of starch. The potatoes containing 20.59 per cent of starch gave only a very light yield—96 bushels per acre. Potatoes had been grown for a generation on the piece of land producing this crop. The highest yield obtained with any of the samples was 640 bushels per acre. The starch content of this sample could not be determined on account of the bad condition of the potatoes when received at the laboratory.—F. W. W.

On propagation of woody plants through grafting under glass protectors, E. LINDGREN (*Kgl. Landt. Akad. Handl. Tidskr., 33 (1894), pp. 58–63*).—The author describes the methods adopted for the propagation of shrubs and trees at the Swedish Agricultural College. The cuttings are placed under glass protectors, so-called grafting tubes, either in sand beds or in flower pots or in the open air. The grafting tubes are glass cylinders closed at one end, of the shape of large test tubes, about 5½ inches long and 1 inch wide. If the cutting is rather long some white moss is wrapped around it below the cut and the grafting tube pressed over the moss and thus held in position. Grafting wax may be used with these glass protectors; but the use of grafting wax has lately been abandoned altogether at the agricultural college after a thorough investigation of the question continued for several

years. Grafting in the open air by means of glass tubes may be advantageously practiced for roses, maple, alder, birch, beech, etc., as well as for fir trees and for gooseberries, currants, etc.—F. W. W.

Some bacterial diseases of plants, PRILLIEUX and DELACROIX (*Compt. Rend., 118 (1894), No. 12, pp. 668–671*).—In 1890 the authors reported a bacterial disease of potatoes and pelargoniums caused by *Bacillus caulivorus*. Since that time numerous plants have been found subject to bacterial diseases, some of which are here given:

Clematis.—The stem is attacked at the collar, and the plant quickly wilts and dies.

Begonias.—These are first attacked in the greenhouse. The petioles drop and the leaves are turned from their normal positions. The parenchyma cells are seen swarming with bacteria. The leaves become yellow and dried in narrow spots and lines, which increase until the the whole leaf is involved and completely destroyed. Later the disease spreads to the stem and other leaves until the whole plant perishes. A similar disease was noticed on gloxinias. The bacillus present was $1\frac{1}{2}$ μ long by $\frac{1}{2}$ to $\frac{1}{3}$ in diameter. When developed either in broth or in gelatin the medium takes on a very marked greenish yellow color, which is increased by shaking. The coloration of the medium resembles that produced by *Bacillus pyocyanus.*

Grapes.—In the grape houses of northern France, and rarely upon the trellises, was observed a disease of grapes characterized by the appearance on the stems of the bunches of bright fawn-colored spots deepening in color as they grow older. The disease spreads, involving stem and fruit, drying them up. It makes its appearance some time before raisin harvest, and hence is of considerable importance. In the infested cells are found numerous bacilli $1\frac{1}{4}$ by $\frac{3}{4}$ μ. In cultures they greatly resemble *Bacillus caulivorus*, except the greenish color is not so marked. The identity of the two is probable.

Specimens of dying vines received from Tunis showed diseased spots upon their roots and the lower parts of the stems. The woody tissue and particularly the medullary rays were browned and had degenerated into a gummy mass, filled with numerous colonies of short bacilli. In cultures the bacilli formed short chains 1 to $1\frac{1}{4}$ μ long, but did not color the culture medium. Inoculations made on the base of sound vines produced all the symptoms of the disease.

The shoots of vines received from St. Aignan showed various lesions resembling in part the anthracnose of grape, but an anatomical examination showed the same condition as that given above for the specimens received from Tunis. The authors consider the bacteria in each case as identical, and think this is the same as the disease known in Italy as "mal nero."

Cyclamen.—The petioles of leaves and peduncles of flowers were seen to bend, wilt, and die, together with the organs which they supported. By cultures the authors separated a very motile short bacillus $\frac{5}{8}$ μ long,

which forms chains of about $1\frac{1}{2}$ μ. Cultures of this did not show the color given by *Bacillus caulivorus*.

Tobacco.—For some years the tobacco crop in Russia and Austria has fallen off, due to the increasing severity of a bacterial disease, and in Garonne Valley of France it has been very destructive. In Germany the disease is called the mosaic disease. It is characterized by the discoloration in spots of the leaf. A little later the spots become dry and of a greenish yellow color, marked with a deeper colored border where the cells become suberized, checking the further spread of disease. It has become quite abundant in southeastern France, where it is known under the name "nielle." In the affected cells was observed a bacillus of about the same dimensions as that reported above for the Cyclamen, which forms into chains, but is a little shorter and more motile. It has not been seen to form spores. In cultures it gives a tawny color to its medium.

Tomatoes.—In several localities of France tomatoes are affected by a bacterial disease. The fruit becomes brown and rotted upon the upper part with the insertion of the style as a center. The cells are full of bacilli $\frac{2}{3}$ to 1 μ long by $\frac{1}{2}$ to $\frac{1}{3}$ in diameter. They do not form into chains, but group themselves as compact zoöglea. The bacillus is slightly motile and changes the color of its culture medium to a light green. It is probable that the infection of the tomato is through the style while the plant is yet in bloom. Successful inoculations with drops of a culture medium placed in the flowers have been made. The disease may also be caused by inoculating with a needle through the skin of the young fruit.

Gladioli.—The bulbs of gladioli sometimes presented on their surface brownish spots where the tissue was deeply corroded. In the rotting cells was found a short bacillus, very motile, 1 to $1\frac{1}{4}$ μ long, which did not change the color of the culture medium.

Apples.—Different varieties were found showing bacterial diseases. When the fruit is cut open portions appear vitreous, and afterwards these cells perish, forming small groups of tawny color, having a cork-like appearance. This disease is due to *Micrococcus* sp., which does not color the culture medium.

The authors expect to continue their experiments and investigations on the bacterial diseases during the ensuing season.—W. H. E.

Means of preserving wood against the attacks of insects, É. MER (*Compt. Rend., 117 (1893), No. 21, pp. 694–698*).—The author found that the species of trees most often attacked by insects are those whose wood is characterized by a large amount of starch. He noticed that the dust resulting from insect ravages contained no starch even when the wood eaten contained this substance in abundance. In order to rid the wood of the starch the bark may be removed from the standing trees three or four months before they are cut. The author also found that a simple girdling of the trees high up on the trunk and the destruc-

tion of any branches putting out below this girdling accomplished the same end.

Oak poles 30 or 40 cm. in diameter were barked one year before being cut, and these, with others not barked, were stored under shelter. A few of the unbarked poles were stripped of their bark as soon as put under shelter, while the bark was left on others. At the end of three years the poles not barked had become much injured. Those stripped of their bark after being cut had been attacked, but less severely than the preceding. Those which had been barked when standing were uninjured.

Oak logs of forty years' growth, which had been girdled toward the end of May, 1890, and cut the following October, were likewise stored, and with them a number of similar logs stripped of their bark after being cut. All these were left for three years in an exposed locality. The oak logs barked after being cut suffered severely, while there was no trace of worm-eating on the logs which were barked five months before being cut. The logs which had been simply girdled some months before cutting and then barked after cutting were also perfectly preserved against insect attacks.

The author regards the spring as the best time for barking or girdling standing trees, and finds that when the operation is performed at this time the starch disappears by autumn and the timber can then be cut without fear of insect ravages.—J. F. D.

The assimilation of lime and phosphoric acid in the animal body, J. NEUMANN (*Jour. Landw., 41 (1893), No. 4, pp. 343–380; abs. in Chem. Centbl., 65 (1894), No. 11, pp. 561, 562*).—The author's purpose was to determine the effect of adding lime and phosphoric acid to the normal diet of immature animals. In the first experiment a calf five and a half weeks old received 15 kg. of skim milk daily during the first period of five days. To this ration there was added during the second period of four days 12 grams of calcium phosphate containing 33.33 per cent of phosphoric acid. In the transition period of two days between the first and second periods 6 and 8 grams, respectively, of the phosphate was added to the food, in order to gradually accustom the animal to it. In every case twenty-four hours was allowed for the digestion of the food, and hence the food of one day was regarded as producing the excrement voided on the following day. The amounts of lime and phosphoric acid consumed, excreted, and retained in the body per day are shown in the following table:

Lime and phosphoric acid consumed, excreted, and retained in the animal body.

	First period.	Transition. period.	Second period.		First period.	Transition period.	Second period.
Lime:	*Grams.*	*Grams.*	*Grams.*	Phosphoric acid:	*Grams.*	*Grams.*	*Grams.*
Consumed	24.63	27.38	29.19	Consumed	30.46	32.83	32.33
Excreted	12.86	14.42	16.77	Excreted	14.91	16.87	18.39
Retained	11.77	12.96	12.42	Retained	15.55	15.96	15.94

Of the phosphoric acid consumed there was retained in the first period 51.1 per cent; in the second period, 46.5 per cent. Of the excreted phosphoric acid the urine contained 13.505 grams in the first period and 16.831 grams in the second; the solid feces contained 1.405 grams in the first period and 1.558 grams in the second.

In the second experiment a calf eight weeks old was used, and was fed daily 16 kg. of skim milk. The first period, including a preparatory period of three days, lasted six days. The transition period lasted two days. In the second period of five days 7.5 grams of calcium carbonate containing 54.23 per cent of lime was added to the milk daily. After another transition period of two days, a third period of five days began in which the food was the same as in the first period. The results appear in the following table:

Lime and phosphoric acid consumed, excreted, and retained in the animal body.

	First period.	First transition period.	Second period.	Second transition period.	Third period.
	Grams.	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Lime:					
Consumed	26.252	27.478	30.008	26.407	26.412
Excreted	14.562	14.854	15.820	15.285	14.776
Retained	11.690	12.624	14.188	11.122	11.636
Phosphoric acid:					
Consumed	34.039	33.863	33.980	34.240	34.247
Excreted	19.511	19.712	19.327	19.696	19.947
Retained	14.528	14.151	14.653	14.544	14.300

Of the 4.07 grams of lime added to the daily ration of milk 2.5 grams, or 61 per cent, was apparently assimilated.—J. F. D.

On some poisonous constituents of rape-seed cake, F. WERENSKIOLD (*Tidskr. norske Landbr., 1 (1894), pp. 57–63*).—The author states that rape-seed cake is the most popular concentrated feeding stuff in Norway, the number of samples sent for examination to the chemical control station at Christiania during 1893 being 98, against 58 samples of cotton-seed meal, 28 of peanut meal, and 18 of rye bran, etc. It is a fact, however, that the quality of the rape-seed cake in the market has greatly deteriorated during late years. Genuine rape-seed meal is but seldom met with, and most of what is sold under that name is manufactured from a highly impure East Indian and South American rape seed, from pure weed seeds (*ravison*) from southern Russia, or from "Sarepta mustard" (*Brassica juncea*, or *B. lanceolata*), or a mixture of this variety and rape seed or weeds. Complaint has frequently been made of the injurious influence of Indian rape seed, of the *ravison*, and of the goods containing Sarepta mustard. It is not known, however, what special components are the cause of the trouble. In some cases it is believed that the volatile oil of mustard (sulphocyanide of allyl) produced from the meal is the cause, but in other cases (as in case of *ravison*) no trace of this oil is obtained. The author investigated carefully three perfectly identical kinds of

seeds, *Brassica lanceolata*, *B. glauca* (East Indian rape), and *Eruca sativa*. The East Indian rape seed examined had the following composition: Moisture, 6.10; ash, 3.40; crude fat, 42.80; crude protein, 23.28 (nitrogen, 3.73); crude fiber, 14.26; and nitrogen-free extract, 10.16 per cent. The sample yielded 0.45 per cent of oil of mustard (determined by Schlicht's method). This would correspond to about 0.7 per cent in the rape seed cake manufactured from the seed. On treatment of the ether extract with dilute sulphuric acid the presence of an alkaloid, choline, was established; sulphocyanide was also found. In the alcoholic extract of the seed about 1.75 per cent of lecithin was found (calculated from the quantity of nitrogen in the extract). The determination of phosphorus in the ether and alcohol extracts (Schulze's method) indicated a lecithin content of 1.20 per cent. Determinations of the sulphocyanide by different methods gave 0.028 per cent and 0.047 per cent present.—F. W. W.

Tuberculosis, W. SAUNDERS and J. W. ROBERTSON (*Canada Central Experimental Farm, Bul. No. 20, Feb., 1894, pp. 36*).—A general discussion of tuberculosis and detailed statements regarding the results secured in making Koch's tuberculin test on 13 calves and 54 other cattle. On some individuals the injection of tuberculin was repeated several times.

In the first test 6 out of 7 milch cows proved tuberculous, showing a rise above the highest normal temperature of from 1.4° to 4.4° F. and of 2.06° to 4.75° F. above the average normal temperature. The cows were slaughtered, and post-mortem examination confirmed the presence of tuberculosis. Later other cattle received one or more injections of tuberculin. Of the 54 head tested (omitting the young calves), embracing the entire herd, 26 gave reactions indicating the presence of tuberculosis. The disease was most prevalent among cows, 17 out of 24 being affected. Three out of 14 bulls gave reactions indicating tuberculosis. Five out of 13 heifers were diseased, giving after injection with tuberculin a rise of from 2.2° to 6° F. above highest normal temperature. It is proposed to use these 5 condemned heifers to test the claim that tuberculin has a curative action on tuberculosis. Injections of small quantities of tuberculin will be made at intervals, the resulting symptoms noted, and the final result ascertained by an examination of the internal organs.

A second injection of tuberculin made a few days after the first had little or no effect on the temperature. The record of the animals tested more than once, while showing some lack of uniformity in the results, indicates that in most instances a period of two to three months is sufficient to restore that condition of the system which admits of a second characteristic reaction on a repetition of the injection.—J. F. D.

The composition and properties of butter made from large and from small fat globules, E. KLUSEMANN (*Inaugural Dissertation, Leipsic, 1893, p. 58; abs. in Chem. Centbl., 1894, I, No. 13, p. 646*).—According

to the author's investigation the size of the fat globules affects the qualities of the butter. The butter made from large globules has a deep yellow color, a good taste, and is hard. That made from small globules, on the other hand, has a whitish color and is inferior in consistency and taste. The larger the proportion of large globules the more completely the milk creams and the more rapidly can the cream be churned. The melting point and point of crystallization is lower for butter made from large globules than for that made from small globules. It appears, further, that with the increase in the number of large globules there is a perceptible decrease in the amount of fatty acids insoluble in water; or, in other words, with the increase of the proportion of small globules there is an increase in the amount of fatty acids insoluble in water. The larger the amount of fatty acids insoluble in water the higher are the melting point and the point of crystallization of the fatty acids. That is, the higher the stearin and palmitin content the lower the olein content. On the other hand, the volatile fatty acids increase with the proportion of large globules in the milk. This, however, is affected by the period of lactation. The olein content also usually increases with the proportion of large globules. The author found that the olein content and the volatile fatty acids corresponded very closely.

The specific gravity of butter made from relatively large globules was found to be lower than that of butter made from small globules. The length of the period of lactation and the stage of lactation influence both the content of volatile and insoluble fatty acids.—E. W. A.

Investigations on the rancidity and the acid number of butter, V. VON KLECKI (*Leipsic, 1894, pp. 66; abs. in Milch Ztg., 23 (1894), Nos. 12, pp. 186, 187; 13, pp. 203, 204*).—The investigations here reported were on the effect of light, air, and bacteria on the rancidity of butter. According to the author, Sigismund found that the rancidity of butter was due to the indirect action of bacteria and the direct action of light and air. The present investigations were carried on simultaneously with those of Sigismund.

The author finds by his experiments that the acidity of butter under ordinary conditions is chiefly due to the activity of bacteria and not to the oxidation of butter fat. With respect to keeping the butter he finds that butter must be kept away from direct sunlight and at a low temperature, not because these factors rapidly increase the acidity of the butter, as has been believed, but because they change the butter in other ways. Indirect sunlight does little harm to butter. The increase in acidity which results from the oxidation of the butter fat in the presence of light is much smaller than that which takes place in the absence of light and air through the activity of bacteria. Consequently antiseptics are of great importance in keeping butter, as has long been known in practice and followed through the use of salt.

The author's résumé of the principal results of his investigations is as follows:

(1) The degree of rancidity of butter can not be judged of directly by the acidity. The acidity increases regularly with the age of the butter, and by the action of heat and sunlight this goes on more slowly than under ordinary conditions. The bacteria are killed by the action of sunlight and their activity is diminished by heat. A butter kept in the sunlight or in a warm place may become rancid without becoming "sour." Conclusions as to the rancidity can be drawn from the acid number only when the conditions under which the butter has been kept are known.

(2) The acidity of butter is due principally to the action of bacteria. Oxidation plays a far inferior part.

(3) The bacteria occurring in butter are principally anaërobic and can vegetate in the dark.

(4) Temperatures of freezing and of the blood hinder the production of acid. The addition of 4 per cent of potassium fluoride to the butter entirely prevents the action of acid-forming bacteria and the butter retains its aroma, taste, and consistency. Fluorides can not be used as preservatives, however, on account of their poisonous qualities.

(6) Common salt hinders the action of bacteria in butter.

(7) The proportion of casein in butter has little effect on the acidity.

(8) Bacteria die after they have produced a certain quantity of acid in the butter. On this account the acid number of butter reaches a maximum after a time, beyond which it does not increase. This maximum corresponds to a rancidity of about 17° to 18°.

(9) Light with the exclusion of air and air with the exclusion of light have the same effect on the production of acid in butter. Acid is produced in neither case and therefore we find in the butter only as much acid as could be produced by the bacteria.

(10) A temperature of freezing and partial darkness have about the same effect in diminishing the production of acid as salt in the light.

(11) The common method of determining the acid number of butter is very faulty. If correct results are to be obtained by this method the action of the carbonic acid of the air must be taken into account.—E. W. A.

On the cooling of cream after pasteurization, T. BERG (*Nord. Mejeri Tidn., 9 (1894), p. 126*).—It has been found in practical trials that cream heated to pasteurization temperature and cooled only slightly produces a richer buttermilk on churning, and consequently a lower yield of butter than cream heated to the same temperature, but afterwards thoroughly cooled. Some trials were made with pasteurized and unpasteurized cream, the mess of cream in each trial being divided into two equal lots, and both treated alike except for the pasteurization of the one lot.

Trials with pasteurized and unpasteurized cream.

		Quantity of cream.	Cooled to—	Time of churning.	Buttermilk.	Fat in buttermilk.	Butter.	Water in butter.
		Kg.	*Deg. C.*	*Min.*	*Kg.*	*Per cent.*	*Kg.*	*Per cent.*
I	Pasteurized to 65° C	75	6	27	69	0.48	17.20	13.3
	Not pasteurized	75	7	33	68	0.42	17.41	14.1
II	Pasteurized to 65° C	82	6	29	71	0.32	17.37	12.8
	Not pasteurized	82	8	30	69	0.30	17.49	13.5
III	Pasteurized to 65° C	77	6	30	66	0.34	17.71	13.2
	Not pasteurized	77	8	30	67	0.33	17.82	13.8

—F. W. W.

Report for 1893 of Chemical and Seed Control Station at Kalmar (Sweden), (*Kalmar, 1894, pp. 28*).—The income of the station for the year was about $2,000 for the chemical station and $800 for the seed control station. During the year 1,907 samples were sent in for examination and analysis. Of this number there were 1,459 samples of dairy products, mainly milk, 146 samples of fertilizers, 129 samples of articles to be examined for poisons, and the rest were feeding stuffs, water, technical products, and miscellaneous samples.

The fat contents of the samples of milk examined ranged between 2 and 5.2 per cent. The monthly averages were as follows:

Fat content of milk analyzed at Kalmar Station during 1893.

	Per cent.		Per cent.
January	3.40	July	3.44
February	3.53	August	3.68
March	3.10	September	3.93
April	3.09	October	4.12
May	3.12	November	3.82
June	3.28	December	3.55

The mean of the monthly averages for the samples from all different sources was 3.53 per cent of fat. This is 0.2 per cent higher than the average fat content of the samples of herd milk analyzed by Swedish stations during 1891 (E. S. R., vol. IV, p. 779). The averages are not directly comparable, however, since a much larger number of analyses was included in the latter result, viz, 12,136 different samples of milk.

At the seed control station 627 samples of seeds were examined and their purity, germinative power, moisture content, etc., determined.—F. W. W.

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Determination of the quality of the cocoa beans (*Zur Werthbestimmung der Cacaobohnen*), T. F. HANAUSEK.—*Chem. Ztg., 18 (1894), No. 25, pp. 441, 442.*

Notes on raffinose (*Notes sur la raffinosè*), E. DELTOUR.—*Assoc. Belge Chim., 7 (1893), No. 5 and 6, pp. 179–187.*

Solvent for cellulose (*Lösungsmittel der Cellulose*), T. F. HANAUSEK.—*Chem. Ztg., 18 (1894), No. 25, p. 441; Chem. News, 69 (1894), No. 1794, p. 174.*

On the chemistry of flower-coloring material (*Zur chemischen Kenntniss der Blumenfarbstoffe*), A. HILGER.—*Bot. Centbl., 57 (1894), No. 12, p. 375.*

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Bacteriological examination of feeding stuffs (*Bakteriologische Untersuchung der Futtermittel*), M. GONNERMANN.—*Chem. Ztg., 18 (1894), No. 27, p. 486.*

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gerung und Ausscheidung des Eisens aus dem tierischen Organismus), A. Lipski.—*Arb. Pharm. Inst. Dorpat, 9, pp. 62–87; abs. in Chem. Centbl., 1894, I, No. 13, p. 639.*

Feeding and respiration experiments with full-grown oxen on the formation of fat from carbohydrates and the relation of the food to the excretion of hydrocarbons (*Fütterungs- und Respirationsversuche mit volljahrigen Ochsen über die Fettbildung aus Kohlenhydraten und die Beziehungen des Futters zur Ausscheidung von Kohlenwasserstoffen*), G. Kühn *et al.*—*Landw. Vers. Stat., 44, pp. 257–573.*

Investigations on the artificial digestion of the protein in feeding stuffs with pepsin and pancreas extracts (*Untersuchungen über die Verdauung stickstoffhaltiger Futterbestandteile durch Behandlung mit Magen- und Pankreas-Extrakten*), G. Kühn, A. Thomas, O. Böttcher, A. Köhler, W. Zielstorff, and F. Barnstein.—*Landw. Vers. Stat., 44, pp. 188–256.*

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Digestion experiments with wet brewers' grains and ground meat (*Versuche über die Verdaulichkeit von frischen Biertrebern und Fleischmehl*), G. Kühn, F. Gerver, E. Kisielinsky and A. Schmidt.—*Landw. Vers. Stat., 44, pp. 1–26.*

Digestion experiments with peanut cake and ground meat (*Versuche über die Verdaulichkeit von Erdnusskuchen und Fleischmehl*), G. Kühn, F. Gerver, A. Thomas, and R. Struve.—*Landw. Vers. Stat., 44, pp. 27–50.*

Digestion experiments with the dried residues from the manufacture of oils from caraway and fennel seed (*Versuche über die Verdaulichkeit der bei der Darstellung ätherischen Kümmel- und Fenchelöls durch Destillation gewonnen und getrockneten Rückstande der Kümmel- und Fenchelsamen der sogenannten extrahierten Kümmels und Fenchels*), G. Kühn, A. Thomas, and O. Neubert.—*Landw. Vers. Stat., 44, pp. 51–72.*

Digestion experiments with rye bran and dried brewers' grains (*Versuche über die Verdaulichkeit der Roggenkleie und der getrockneten Biertreber*), G. Kühn, G. König, and O. Böttcher.—*Landw. Vers. Stat., 44, p. 73–111.*

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The disembittering of lupine (*Die Entbitterung der Lupinen*), G. Waechter.—*Inaugural Dissertation, Leipsic, 1893, pp. 106; abs. in Chem. Centbl., 1894, I, No. 11, p. 560.*

Effect of dried brewers' grains and dried distillery slop on the secretion of milk (*Die Einwirkung der getrockneten Biertraber und der getrockneten Getreideschlempe auf die Milchsekretion des Rindes*), O. Och.—*Inaugural Dissertation, Leipsic, 1893, pp. 67; abs. in Chem. Centbl., 1894, I, No. 11, p. 562.*

Milking one side of the udder at a time or both sides at the same time (*Ueber kreuzweises und gleichseitiges Melken*), F. Albert.—*Milch Ztg., 23 (1894), No. 15, pp. 231–234.*

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The history and present state of the sheep-breeding industry in the Argentine Republic, H. Gibson.—*Buenos Aires and London; pp. 297; reviewed in Jour. Roy. Agr. Soc. England, 5 (1894), No. 17, pp. 162–167.*

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VETERINARY SCIENCE AND PRACTICE.

Practical results of vaccination against charbon and rouget (*Résultats pratiques des vaccinations contre le charbon et le rouget en France*), C. Chamberland.—*Ann. Inst. Pasteur, 8 (1894), No. 3, pp. 161–165.*

Experimental tuberculosis of the kidneys (*Tuberculose expérimentale du rein*), A. Borrel.—*Ann. Inst. Pasteur, 8 (1894), No. 2, pp. 65–82, plates 3.*

Poisoning of cattle by eating leaves of the yew tree (Taxus baccata), (*Empoisonnement du bétail par les feuilles d'if*), L. Grandeau.—*Jour. Agr. Prat., 58 (1894), No. 7, pp. 229, 230.*

New infectious disease in turkeys, McFadyean.—*Jour. Roy. Agr. Soc. England, 5 (1894), No. 17, pp. 123–126.*

DAIRYING.

The composition of milk and its products, H. D. Richmond.—*Analyst, 1894, Apr., pp. 73–87.*

On the importance of fat determinations for the improvement of milch cows (*Nogle undersögelser om betydningen af fedtbestemmelsen som hjälpemiddel ved udviklingen af vort malkekväg*), A. La Cour.—*Ugeskr. Landm., 39 (1894), pp. 129–132.*

Adulteration of butter (*De la fraude des beurres*), Jouland.—*Rev. Internat. Falsif., 7, (1894), No. 7, pp. 120–122.*

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Microbes and their role in the dairy (*Les microbes et leur rôle dans la laiterie*), E. de Freudenreich.—*Paris: G. Carri, 1894.*

Pasteurizing skim milk (*Ueber das rationelle Pasteurisieren der Magermilch*), Du Roi.—*Molk. Ztg., 8 (1894), No. 12, pp. 173, 174, figs. 2.*

Stutzer's sterilizer (*Neue Vorrichtungen zum Sterilisieren von Milch, sowie zum Konservieren von Fruchten und Gemüsen*), A. Stutzer.—*Deut. landw. Presse, 21 (1894), No. 27, pp. 265, 266; No. 28, p. 279.*

On the manufacture of cheese in Switzerland and Holland (*Om ost-tillverkningen i Schweiz och Holland*), A. Friis.—*Nord. Mejeri Tidn., 19 (1894), pp. 117, 118, 129.*

On the development of the Swedish cheese manufacture (*Naagra drag af vaar ost-tillverknings utvekling*), A. Nathorst.—*Tidskr. Landtmän, 15 (1894), pp. 159–162.*

The Swedish cheese exhibition in Stockholm (*Allm. svenska ost-utställningeni Stockholm*).—*Nord. Mejeri Tidn., 19 (1894), pp. 89, 90, 101, 102, 113, 114, 125, 126.*

STATISTICS.

Contributions to the agricultural statistics for Prussia for the year 1892 (*Beiträge zur landwirthschaftlichen Statistik von Preussen für das Jahr 1892*).—*Landw. Jahrb., 22 (1893), Sup. 2, pp. 623.*

EXPERIMENT STATION NOTES.

Kansas Station.– Operations at the pumping station near Garden City will begin at once under direction of the station council, with F. W. Dunn as assistant. Mr. Dunn has had experience with irrigation in Colorado. In this enterprise the station will be aided by the U. S. Geological Survey, and by the Division of Agricultural Soils of the U. S. Department of Agriculture.

Michigan Station.—The branch stations have been discontinued with the exception of the fruit station at South Haven and one at Grayling on the "Jack-pine plains." The plan is being tried of publishing several bulletins at a time under one cover. The station is receiving samples for trial of various styles of farm fences.

New Hampshire Station.—Weekly press bulletins are being sent to all newspapers in the State. D. E. Stowe, assistant agriculturist, has severed his connection with the station, the director taking personal charge of that part of the work. The station buildings are now practically completed. Coöperative fertilizer experiments are to be carried on in conjunction with the Pomona granges of the State, each Pomona grange selecting a man to carry on this work under the supervision of the station.

Ohio Station.—The station is purchasing small herds of pure-bred cattle of several breeds for the purpose of instituting a comparative breed test, the design being to study both milk and meat production.

West Virginia Station.—In connection with the formal opening of the remodeled and enlarged station building meetings of farmers were held April 5 and 6. On the former day three State associations were organized, viz, West Virginia Wool Growers' and Sheep Breeders' Association, State Dairymen's Association, and West Virginia Horticultural Society. Interesting papers were read at the meetings of these new organizations. On April 6 a public meeting was held in the commencement hall of the State University. Hon. J. W. Mason gave an address on sugar-beet culture, showing the importance of this industry and urging the farmers of West Virginia to experiment with this crop. Dr. J. A. Myers, director of the station, reviewed the work of the station since its organization in 1888. The principal lines of work pursued have been those relating to the creamery industry, fertilizer analysis (including methods of analysis), botany, horticulture, and entomology. Especial attention was called to the introduction of a parasite to destroy the insects ravaging the great spruce and pine forests of the State. Reference was also made to the investigations of the entomologist which indicate that potato scab and rot may be caused by fungus gnats, as stated in a previous number of the Record (page 935). Later in the day Prof. Hopkins read a paper giving a somewhat detailed account of these investigations. The director of this Office made a brief address, extending the congratulations of this Department to the West Virginia University and Station on the completion of the new building. The exercises were closed with a public reception given in the evening by the station staff and their ladies.

In the new building the station has ample accommodations for offices, laboratories, library, and museum. Immediately adjoining the station building are well-equipped greenhouses, with apparatus for experiments in the use of electric light. The sta-

tion has no farm and therefore does not carry on field experiments, but in other lines its work is well established and its future prospects very encouraging. The station has issued three annual reports and thirty-six bulletins. These publications are distributed to about 30,000 farmers, being addressed to 1,000 post offices in the State.

WYOMING STATION.—The work in meteorology has been transferred from B. C. Buffum to J. D. Conley, physicist of the station.

DEGREE IN AGRICULTURE AT CAMBRIDGE.—The University of Cambridge has decided to grant a diploma in agriculture to candidates passing an examination in botany, chemistry, physiology, hygiene, entomology, geology, mechanics, engineering, bookkeeping, and surveying. The work leads to the degree of master of agriculture.

SUMMER HOT WINDS OF THE GREAT PLAINS.—In a forty-page paper under this title read before the Philosophical Society of Washington January 20, 1894, I. M. Cline collates and critically reviews the data relating to the peculiar hot dry winds which occur along the eastern slope of the Rocky Mountains, with a view to determining "the character and extent of such winds and when and under what conditions they may be expected. * * *

"One of the most striking features of these winds is that while the atmosphere is heated generally and shows an excess of temperature over the territory affected, abnormally heated narrow currents are often observed between which the air is much cooler. These currents are of very short duration, but often occur in rapid succession at neighboring places. These hot currents occur in groups, covering, as a rule, a territory of a few hundred acres. The currents are separated from each other by only short distances, ranging from a few yards up to a few hundred yards. Sometimes groups of hot winds separated by only a few miles cover several counties, and again several miles intervene between such groups. In this manner an occurrence of these winds sometimes covers the whole or part of a State or two or three States.

"The tremor of heat, similar to that seen rising from a hot furnace, is sometimes distinctly visible in these currents. * * * We have no definite record of the temperature of the hot winds themselves, but the thermometers in the affected district range generally, during the prevalence of these winds, from 100° to 110° in the shade, and at times even higher. * * *

"The hot winds are always referred to as extremely dry. Although very few hygrometric observations have been made in connection with them, yet those on record confirm the general statement regarding this condition. * * *

"The hot winds are likely to occur between May 15 and September 15, but are most frequent during July and August. * * * The length of time during which a period of these winds is likely to prevail varies from a few hours to three days. Sometimes, but rarely, two or three of these periods of hot winds follow each other in rapid succession. * * *

"The direction from which the hot winds blow is the same as that of the atmosphere near the earth's surface prevailing over the section in which they occur at the time of their occurrence. * * * The velocity of the hot winds varies considerably in different periods. It is sometimes noted as a light breeze and from that to a gale. It is not the same in all sections on the same date; while it is blowing a gale at one place it is noted as a light breeze at another place less than 100 miles distant. * * *

"A striking characteristic of the hot winds is their effect on vegetation. While they are always noted as causing vegetation to wilt and droop, the more intensely hot winds burn tender vegetation to a crisp in a few minutes, without relation to the amount of moisture present in the soil or general atmosphere. Some of the most destructive of these winds have been known to occur when both the soil and atmosphere were saturated with moisture. The tops of corn and other hardier vegetation are burned, while near the earth they are not damaged. The leaves of trees

dry to a crisp in some instances so that they crumble at the touch of the hand, and apples bake on the trees. Corn when in silk and wheat when in dough suffer more severely than at any other stage of their growth. Wheat in this stage when affected suffers severely. The heat and rapid evaporation completely dry up the germ wherever the hot winds strike. Fortunately severe damage from hot winds is not general over an affected district, but covers only small parts of the different farms. Sometimes entire counties remain uninjured. Under the influence of these winds the skin becomes dry and parched and perspiration becomes entirely insensible. The more intensely heated currents are said to be almost insufferable. When a period of hot winds continues for two or three days and the general atmosphere becomes very hot and dry vegetation suffers generally, but as a rule it recovers, except in those streaks visited by the intensely heated currents, although the yield is reduced somewhat and is reduced materially if two or three of these periods follow each other in rapid succession, as has sometimes been the case. * * *

"[These hot winds] have only occurred with sufficient intensity to attract the notice of observers in ten years out of the past twenty-three, and have not been of sufficient extent and severity to damage crops to a degree worthy of notice except in three or four years. Even when severe their destructiveness is confined to narrow limits, and, except in rare cases, no great damage results from their effects except to a field here and there, and these are only damaged in spots. * * *

"Apparently the conditions on which the development of hot dry winds over the eastern slope of the Rocky Mountains and eastward depend are the presence of nearly stationary or slow-moving low-pressure areas along the eastern slope and then eastward, with a relatively high pressure over the Pacific off the coast of Oregon or in that vicinity. In no instances are hot winds noted with a low-pressure area which moves eastward with any degree of rapidity. * * *

"With these conditions it can readily be seen that an area of low pressure, remaining nearly stationary over the eastern slope of the Rocky Mountains for a few days, would cause the wind to continue its course across the divide toward such low-pressure area. The atmosphere, as it moves eastward from the Pacific coast to the crest of the continental divide, is always accompanied by clouds and more or less rain, and at the outset is nearly saturated with moisture. In crossing the divide to reach the low-pressure area this air must ascend to a height of 10,000 to 15,000 feet. From the deductions of Dr. Hann, Prof. Bezold, Prof. Ferrel, and others, we have learned that saturated air while ascending cools at the rate of about 1° F. in each 400 feet elevation, instead of 1° in about 100 feet, as is the case with dry air. The reduction of temperature in ascending moist air is compensated about one half by the heat liberated in the condensation of moisture resulting from cooling in the ascent. According to Dr. Hann one half of the vapor of the atmosphere is below an elevation of 6,000 feet and eight tenths is below 15,000 feet, hence we can readily see how small an amount of moisture can be retained by the atmosphere after crossing a mountain range with an altitude of 10,000 to 15,000 feet. * * * This dry air, in descending over the eastern slope, after having dissipated the cloud carried over, gains temperature dynamically nearly twice as rapidly in a corresponding distance, as it cooled in ascending the western slope. In moving toward the low-pressure area this dry air takes up the circulation around that area, is carried over the plateau region from a northerly direction, and flows down over the eastern slope from a westerly and then a southerly direction, depending on the trend of the isobars. The mass of air in moving down the slope loses a great deal of the warmth derived dynamically by radiation to the earth and the surrounding atmosphere, and also by intermixture, and it reaches the lower altitudes with dryness and increased temperature, but with less warmth than if the descent had taken place rapidly. The dry air is carried forward in the upper strata more rapidly than in the layers near the earth's surface, and when thus carried out over moister and less dense air its tendency is to descend here and there through that air to the earth's surface, while the moist and less dense air ascends

at neighboring points and forms the scattering clouds often noted in connection with these winds. * * * In order to become so intensely hot [the currents] descend rapidly or the warmth gained dynamically is lost by radiation. After the earth's surface is reached both radiation and intermixture become rapid, and each individual current, except in the case of a very large one, is of short duration. This explanation accounts both for the general heating of the atmosphere and for the intensely hot currents, and also accounts for the occurrence of these hot winds at any time of the day or night from any direction, and without regard to the condition of the soil, whether wet or dry.

"In these descending currents or masses of air evidently very little intermixture with the general atmosphere takes place until the earth's surface is reached. They appear to retain their identity with sharply defined boundaries, to reach the earth with almost extreme dryness, and with warmth gained dynamically when the descent has been rapid. * * *

"These winds are a feature of the climate of the eastern slope of the Rocky Mountains, and can not be expected to disappear or even become less frequent; neither are they likely to become more so, and, while nothing can be done to prevent their occurrence, steps should be taken to ameliorate their effects, if practicable. It appears that anything which would furnish an extended surface from which these hot and dry winds could absorb moisture, and thus by evaporation reduce their temperature as well as increase their moisture, would lessen their geographic extent and their injurious effects on vegetation. A generous growth of hardy timber appears to be the only material suggestion in this connection."

Fertilizer inspection and analysis in Pennsylvania.—In a twenty-eight page bulletin of the Pennsylvania State Board of Agriculture, W. Frear, chemist of the board, gives analyses and valuations of 326 samples of fertilizers collected and analyzed during the period from August 1, 1893, to January 1, 1894, accompanied by the text of the State fertilizer law and general information regarding the valuation of fertilizers, etc., by T. J. Edge, secretary of the board.

Recent publications relating to carbohydrates.—An excellent résumé of this subject by Prof. W. E. Stone is published in *Agricultural Science* (*vol. VIII*), pp. 61–74.

Recent articles by station workers.—In *Botanical Gazette* (*18* (*1894*), *No. 4*): Artificial cultures of an entomogenous fungus (*Isaria farinosa*), G. F. Atkinson, pp. 127–135.

In *Science* (*vol. XXIII*): Autumn coloring of leaves, G. W. McCluer, pp. 133, 134.

In *American Gardening* (*vol. XV*): Raspberry anthracnose, L. R. Taft, p. 221.

In *Garden and Forest* (*vol. XII*): Winter protection of fruit trees, W. F. Massey, pp., 156, 157; The effects of untimely frosts, W. F. Massey, p. 168.

In *Agricultural Science* (*vol. VII*): Summary of American seed tests, C. L. Parsons, pp. 541–545; Experiments in salting butter, W. S. Sweetser and R. J. Weld, pp. 546–548; Recent investigations concerning *Rhizobia* and free nitrogen assimilation, A. Schneider, pp. 549–556; (vol. VIII): Leather refuse: its value in agriculture, J. B. Lindsey, pp. 49–61.

In *Entomological News* (*May, 1894*): Notes on a few species of reared Coleoptera, F. M. Webster, pp. 140, 141.

In *Journal of Cincinnati Society of Natural History* (*January, 1894*): Observations on some *Entomophthoreæ*, F. M. Webster, pp. 173–177.

In *Canadian Entomologist* (*vol. XXVI*): Butterflies common to Norway and Arctic North America, F. M. Webster, pp. 117–120.

LIST OF PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE.

MAY, 1894.

DIVISION OF BOTANY:

Contributions from the U. S. National Herbarium, vol. II, No. 3.

OFFICE OF EXPERIMENT STATIONS:

Experiment Station Record, vol. V, No. 9.

DIVISION OF ENTOMOLOGY:

Insect Life, vol. VI, No. 4.

DIVISION OF STATISTICS:

Report No. 115 (new series), May, 1894.—Report of the Statistician.

DIVISION OF CHEMISTRY:

Bulletin No. 40.—Record of Experiments with Sorghum in 1893.

DIVISION OF RECORDS AND EDITING:

List of Publications of the U. S. Department of Agriculture for the Five Years 1889–1893, inclusive.

DIVISION OF AGRICULTURAL SOILS:

Circular No. II.—Instructions for Taking Samples of Soil for Moisture Determinations.

WEATHER BUREAU:

Monthly Weather Review, March, 1894.

Circular of Information.—Protection from Lightning.

LIBRARY:

Bulletin.—Accessions to the Department Library.

LIST OF STATION PUBLICATIONS RECEIVED BY THE OFFICE OF EXPERIMENT STATIONS

MAY, 1894.

AGRICULTURAL EXPERIMENT STATION OF THE AGRICULTURAL AND MECHANICAL COLLEGE OF ALABAMA:

Bulletin No. 55, April, 1894.—A New Disease of Cotton.

AGRICULTURAL EXPERIMENT STATION OF THE UNIVERSITY OF CALIFORNIA:

Bulletin No. 104, April, 1894.—Investigations of California Olives and Olive Oils.

THE CONNECTICUT AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 119, May, 1894.—The Babcock Test as a Basis for Payment in Cream-gathering Creameries.

AGRICULTURAL EXPERIMENT STATION OF INDIANA:

Sixth Annual Report, 1893.

KANSAS AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 42, December, 1893.—Experiments with Oats.

Bulletin No. 43, December, 1893.—Experiments with Sorghum and Sugar Beets.

Bulletin No. 44, December, 1893.—Further Study of Native Grapes.

Sixth Annual Report, 1893.

KENTUCKY AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 49, March, 1894.—Destructive Locusts in Kentucky; The Bud Worm of Tobacco.

Bulletin No. 50, April, 1894.—Fruit Growing in Kentucky; Notes upon Vegetables.

LOUISIANA EXPERIMENT STATIONS:

Bulletin No. 27 (second series).—Results of the Year 1893.

MAINE STATE COLLEGE AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 7 (second series), February 15, 1894.—Inspection of Fertilizers.

Bulletin No. 8 (second series), March 1, 1894.—Spraying Experiments.

Bulletin No. 9 (second series), March 15, 1894.—Tomatoes.

Bulletin No. 10 (second series), April 1, 1894.—Cauliflowers.

Bulletin No. 11 (second series), April 2, 1894.—Corn as a Silage Crop.

HATCH EXPERIMENT STATION OF THE MASSACHUSETTS AGRICULTURAL COLLEGE:

Bulletin No. 24, April, 1894.—Insecticides; The Horn Fly.

Bulletin No. 25, April, 1894.—Fungicides and Insecticides; Tests of Grapes.

Meteorological Bulletin No. 64, April, 1894.

EXPERIMENT STATION OF MICHIGAN AGRICULTURAL COLLEGE:

Bulletin No. 107, February, 1894.—Fattening Lambs.

Bulletin No. 108, February, 1894.—Potatoes and Potato Scab.

Bulletin No. 109, February, 1894.—Variety Tests of Vegetables.

Bulletin No. 110, February, 1894.—The External Conformation of the Horse.

AGRICULTURAL EXPERIMENT STATION OF THE UNIVERSITY OF MINNESOTA:

Annual Report, 1893.

AGRICULTURAL EXPERIMENT STATION OF NEBRASKA:

Bulletin No. 34, May 1, 1894.—Chinch Bugs.

Bulletin No. 35, May 1, 1894.—Alfalfa; Farm Notes.

Bulletin No. 36, May 1, 1894.—Experiments in the Culture of the Sugar Beet in Nebraska.

NEW HAMPSHIRE AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 20, March, 1894.—Effect of Food on Milk.

Bulletin No. 21, April, 1894.—Farmyard Manures and Artificial Fertilizers.

NEW JERSEY AGRICULTURAL EXPERIMENT STATIONS:

Bulletin No. 99, April 4, 1894.—The Pear Midge.

NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 96, January 20, 1894.—Miscellaneous Agricultural Topics.

Bulletin No. 98, March 1, 1894.—Some Leguminous Crops and their Economic Value.

Bulletin No. 99, April 15, 1894.—Thread Worm of Pork.

Bulletin No. 100, March 26, 1894.—Our Common Insects.

Special Bulletin No. 20, April 21, 1894.—Fertilizer Analyses and the Fertilizer Control.

Special Bulletin No. 21, May 22, 1894.—Fertilizer Analyses and the Fertilizer Control.

OREGON AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 29, February, 1894.—Notes on Vegetables, Fruits, Pruning, etc.

Bulletin No. 30, March, 1894.—Potatoes; Roots.

Bulletin No. 31, April, 1894.—Progress of Entomological Work; Capons and Caponizing.

SOUTH DAKOTA AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 38, January, 1894.—Feeding Wheat to Hogs.

AGRICULTURAL EXPERIMENT STATION OF UTAH:

Bulletin No 27, March, 1894.—Irrigation: Early, Late, and Usual.

Bulletin No. 28, April, 1894.—The Value of Grass in the Production of Pork; Exercise *vs.* Non-exercise of Pigs.

VERMONT AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 41, April, 1894.—Analyses of Commercial Fertilizers.

DOMINION OF CANADA.

DEPARTMENT OF AGRICULTURE:

Bulletin (special), May 1, 1894.—Dairying in Ontario.

ONTARIO AGRICULTURAL COLLEGE:

Bulletin No. 93, April 16, 1894.—Dairy Bulletin.

Bulletin No. 94, May 16, 1894.—The Care of Milk for Cheese Factories and Creameries.

ONTARIO BUREAU OF INDUSTRIES, TORONTO:

Bulletin No. 49, April 24, 1894.—Crops and Live Stock in Ontario.

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PUBLICATIONS OF THE OFFICE OF EXPERIMENT STATIONS.

The Office of Experiment Stations issues three classes of publications for general distribution:

(1) Experiment Station Record, and (2) Bulletins, which are more or less technical. It is the practice to send to persons applying for them one or more numbers, from which they may judge of their usefulness, but not to place any names upon the mailing list until after receipt of applications on special blanks furnished by the Office.

(3) Farmers' Bulletins, which are brief and popular in character, and are sent on application. These bulletins are issued as part of the general series of Farmers' Bulletins of the Department of Agriculture.

The following publications have been issued:

Experiment Station Record, vol. I, 6 numbers; vol. II, 12 numbers; vol. III, 12 numbers and index; vol. IV, 12 numbers, including index; vol. V, Nos. 1–9. Copies of the Station and Department publications abstracted in the Record can, in many instances, be obtained on application.

Bulletins.—No. 1, Organization and History of the Stations; No. 2, Digest of Annual Reports of the Stations for 1888, in two parts; No. 3, Report of Meeting of Horticulturists at Columbus, Ohio, June, 1889; No. 4, List of Station Horticulturists and Outline of their Work; No. 5, Organization Lists of Stations and Colleges, March, 1890; No. 6, List of Station Botanists and Outline of their Work; No. 7, Proceedings of the Fifth Annual Convention of the Association of American Agricultural Colleges and Experiment Stations, Washington, D. C., August, 1891; No. 8, Lectures on Investigations at Rothamsted Experimental Station; No. 9, The Fermentations of Milk; No. 10, Meteorological Work for Agricultural Institutions; No. 11, A Compilation of Analyses of American Feeding Stuffs; No. 12, Organization Lists of the Agricultural Experiment Stations and Agricultural Schools and Colleges in the United States, June, 1892; No. 13, Organization Lists of the Agricultural Experiment Stations and Agricultural Schools and Colleges in the United States, April, 1893; No. 14, Proceedings of a Convention of the National League for Good Roads, January, 1893; No. 15, Handbook of Experiment Station Work; No. 16, Proceedings of the Sixth Annual Convention of the Association of American Agricultural Colleges and Experiment Stations, New Orleans, Louisiana, November, 1892; No. 17, Suggestions for the Establishment of Food Laboratories; No. 18, Assimilation of Free Atmospheric Nitrogen by White and Black Mustard; No. 19, Organization Lists of the Agricultural Experiment Stations and Agricultural Schools and Colleges in the United States, January, 1894.

Miscellaneous Bulletins.—No. 1, Proceedings of Knoxville Convention of Association of Agricultural Colleges and Stations, January, 1889; No. 2, Proceedings of Washington Convention of the Association, November, 1889; No. 3, Proceedings of Champaign Convention of the Association, November, 1890. (Series discontinued.)

Farmers' Bulletins.—No. 1, The What and Why of Agricultural Experiment Stations; No. 2, Illustrations of the Work of the Stations; No. 9, Milk Fermentations and their Relation to Dairying; No. 11, The Rape Plant; No. 14, Fertilizers for Cotton; No. 16, Leguminous Plants for Green Manuring and for Feeding.

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THE AGRICULTURAL EXPERIMENT STATIONS IN THE UNITED STATES.

R. Kent Beattie

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U. S. DEPARTMENT OF AGRICULTURE

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Vol. V No. 11

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EXPERIMENT STATION RECORD.

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Representatives of a number of State live stock sanitary boards convened at this Department Tuesday, June 19, to consider the advisability of greater uniformity in State laws regarding infectious and contagious diseases of live stock, and to discuss some of the diseases now demanding serious attention. The sessions extended over three days. Seventeen delegates were present, representing 9 States and the Bureau of Animal Industry of this Department.

Hon. Levi Stockbridge, of Massachusetts, and Dr. F. Dye, of New Jersey, presided at the different sessions.

Dr. J. G. Turner, State veterinarian of Missouri, read a paper on uniform State laws for the prevention and suppression of infectious and contagious diseases of live stock. Dr. R. Ward, chief veterinary inspector of the Maryland live stock sanitary board, delivered an illustrated lecture on glanders. Dr. Charles P. Lyman, secretary of the Massachusetts board of cattle commissioners and dean of the veterinary department of Harvard University, read a paper explaining the new sanitary laws of Massachusetts. A paper was read which had been prepared by Dr. J. H. Kellogg, of Battle Creek, Mich., on bovine tuberculosis and its transmission to the human race through meat and milk of tuberculous animals. In discussing the latter paper, Dr. D. E. Salmon stated that he did not regard as substantiated the theory recently promulgated that the toxic products of bacteria present in the milk and flesh of tuberculous animals, even after sterilization and cooking, are injurious. He called attention to the minute quantities in which these products are probably present, and to the fact that experiments with animals indicate that much larger quantities of such materials may be taken into the alimentary canal with impunity than could be safely introduced into the system by injection. He also expressed doubt as to the communicability of bird tuberculosis to other animals, and *vice versa.*

In the discussion on tuberculosis attention was called to the fact that the tuberculin test is the only approximately exact method of diagnosing the disease, that this test requires much time and is costly, and that preliminary analyses made by the Department of Agricul-

ture had shown that during the test the milk of cows is considerably affected in chemical composition, rendering it necessary to throw away the milk of at least one milking. This latter fact complicates the difficulties of testing large herds.

In the discussion of State laws bearing on diseases of domestic animals most of the speakers expressed themselves as favoring uniformity in the substance and aim of these laws rather than in details. The special need for uniform compensation for slaughtered animals was shown. Coöperation between the State boards and the Bureau of Animal Industry was urged.

In a talk on ticks as the cause and carriers of Texas fever, Dr. Salmon stated that the Department had recently received from Texas a kind of tick, thought to be new, but which had been found in New Mexico once before. He stated that cattle in the ears of which this tick was found suffered from a disease manifested by swelling about the neck. That the tick was the cause of this disease had not been demonstrated, though the occurrence of the tick and the disease together were noted as a curious coincidence.

A permanent organization was formed, under the name of the National Live Stock Sanitary Association, to be composed of the State live stock sanitary commissions and their secretaries, the State veterinarians of the several States, and any other State and national officials having control of the diseases of live stock.

For the ensuing term the following officers were elected: President, J. A. Potts, of Missouri; vice-president, Dr. Robert Ward, of Maryland; secretary, A. M. Brownlee, of Illinois. A committee of five was appointed to draft a constitution and by-laws, to prepare a circular setting forth the objects of the association, and to interest in the association the live stock sanitary commissions of the several States. Chicago was chosen as the next place of meeting. The secretary was instructed to have printed for distribution 500 copies of the proceedings of the convention.

A REVIEW OF RECENT WORK ON DAIRYING.*

E. W. ALLEN.

DAIRY BACTERIOLOGY.

The term dairy bacteriology is here used to include all kinds of studies on the microörganisms in dairy products and the changes they effect. Investigation in these lines has developed very rapidly during the past few years. While much has already been learned concerning the numerous changes in milk and its products and their causes, the field is comparatively new and presents a multitude of subjects for extended investigation.

In a paper on the source of bacteria in milk L. Schulz[1] concludes that the high germ content of milk is not necessarily due to carelessness, but is partially accounted for by germs working up into the end of the teat, where, under the favorable temperature, they increase rapidly between the milkings. They are largely washed out in the first portion of the milk drawn, which accounts for the higher germ content of this portion. In some tests the strippings were found to be sterile or nearly so. F. Schuppan[2] has shown that ordinary market milk contained, when five or six hours old, about 1,000,000 germs per cubic centimeter. He explains that this might be very materially reduced by careful feeding and proper treatment of the milk. Filtering milk through sponge filters removes many of the germs and allows the milk to be kept sweet longer, but the cleaning and sterilizing of these sponge filters has given considerable trouble, consequently sand filters have been used of late. These are said not to affect the fat content of the milk, at least only slightly.

In studying the germ content of the market milk of Dorpat, Russia, H. Knochenstiern[3] found that milk which came from large estates and had been carefully treated contained far less germs than that coming from smaller farms where less care was exercised.

In studying bitter milk, M. Bleisch[4] isolated a bacteria which, when inoculated into sterilized milk, caused it to become bitter. He believes it to belong to the same species as the forms described by Weigmann,

* Continued from p. 974.

[1] Arch. Hyg., 14, p. 260; abs. in E. S. R., vol. IV, p. 214.

[2] Centbl. Bakt. und Par., 13, pp. 527-531, 555-559; abs. in Bot. Centbl., 56 (1893), pp. 376, 377.

[3] Inaugural Dissertation. Dorpat, 1893; abs. in Chem. Centbl., 1893, II, p. 62.

[4] Ztschr. Hyg., 13, pp. 81-99; abs. in Chem. Centbl., 1893, I, p. 434.

Krüger, and others. It was capable of motion, and produced spores which were not destroyed by direct contact with live steam for six hours. Sterilizing in hermetically sealed bottles was more effective. Vandenhoydonck[1] reports a case in which all the cows in a little village commenced to give bitter milk. The milk frothed badly during creaming, appeared to be in vigorous fermentation, and was very bitter. On examination the cows were found to be perfectly healthy. The source of the trouble was finally discovered in the excessive feeding of Swedish turnips which had been washed in foul ditch water. Soon after the turnips were discontinued the milk became normal.

A case of soapy milk, which failed to sour and had a soapy taste, was traced by H. Weigmann and E. Zirn[2] to the straw used for bedding. The straw was moist and discolored. All five forms of bacteria found in the milk were found on the straw. The bacteria got onto the udder and from there into the milk. The trouble disappeared when the straw was discontinued. Another case in which the milk would not sour and had a soapy taste was traced to the hay on which the same bacteria were found as on the straw. Pasturage on certain pieces of land also gave rise to this trouble. The remedy was found in changing the pasture. The authors conclude that the kind of food may indirectly have an effect on the bacteriological composition of milk, and recommend that cows be milked before feeding or bedding.

In a lengthy paper on a slimy fermentation of milk, G. Leichmann[3] attributes it to an organism which he isolated and which he describes. At ordinary temperature it caused no change in sterilized milk beyond a slight increase in acidity. In the culture oven it rendered milk stringy and sour in twelve hours; as the souring progressed the casein became gelatinous, and a whey separated which remained stringy for a time and gradually became thin and slimy. Milk sugar was found to be essential to this fermentation and was believed to be decomposed by it. The chief products of the fermentation were lactic acid and a gummy slime.

Experiments made by M. Lang and E. von Freudenreich[4] on *Oïdium lactis* indicate that this organism can ferment glucose, milk sugar, cane sugar, and maltose, and can decompose the albuminoids of milk.

Uhl[5] determined for a number of samples of milk the length of time they required to be heated in the breeding oven before souring. He found that this depended upon the number of germs present. One sample, which was heated at 18° C. for thirty-two hours before souring, and contained only 10,500 germs per cubic centimeter, was obtained with unusual care.

[1] Schweiz. Arch., 35; abs. in Molk. Ztg., 7 (1893), p. 693, and E. S. R., vol. v, p. 720.

[2] Milch Ztg., 22 (1893), pp. 569–571; abs. in E. S. R., vol. v, p. 431.

[3] Landw. Vers, Stat., 43, pp. 375–398.

[4] Landw. Jahrb. Schweiz., 7 (1893), pp. 229–237; abs. in E. S. R., vol. v, p. 919.

[5] Ztschr. Hyg., 12, pp. 475–484; abs. in Chem. Centbl., 1893, I, p. 168.

H. Timpe[1] studied the relation of the phosphates and casein to lactic fermentation. As the lactic acid is injurious to the growth of bacteria which render milk sour, it must be neutralized for the souring to continue. He believes it is by the combined action of the phosphates and the casein in fixing the lactic acid produced, both by giving up alkali and by direct neutralization, that the relatively high percentage of lactic acid in sour milk is attained. Curdling is influenced by the amount of polybasic phosphates present, the casein not being precipitated until all of these are changed to monobasic salts; then the casein is robbed of its alkali by the lactic acid formed and its precipitation effected.

F. J. Herz[2] details the results of some fermentation tests on milk which showed some peculiarity or was from cows sick with mouth-and-foot disease or udder tuberculosis.

Studying the behavior of anthrax bacilli in milk, O. Caro[3] found that in freshly drawn milk they increased during the first three hours and then diminished. They lost their virulence in eighteen hours at 37° C. and in twenty-four hours at 15° or 16° C. This is attributed to the acid formed, for when magnesium oxide was added and no free acid observed for twenty-four hours the bacilli multiplied rapidly and retained their virulence.

Experiments by L. Heim[4] indicate that cholera germs are more rapidly destroyed when milk is kept in a warm place and allowed to sour than when it is kept cool, although it was found that the germs could retain their virulence for some time in sour milk. Cholera germs retained their virulence in butter for over a month, although there was a difference in butter as to the time they could live in it. The germs lived only a day or two in cheese.

Niederstadt[5] found that by the centrifugal treatment of 300 liters of milk about 130 grams of sediment was obtained. The cream was richer in bacteria than the sediment. The separator effected no purification of milk from bacteria, since 75 per cent of the bacteria went into the cream. Tuberculosis germs were the most completely separated with the cream, while cholera bacilli remained in suspension, *i. e.*, went into the skimmed milk.

In testing milk for tuberculosis W. Thörner[6] recommends that the milk be treated with potash solution to saponify the fat, acetic acid added to dissolve the casein, and then whirled in a centrifuge for ten minutes. The liquid is then poured off, the sediment washed with

[1] Landw. Vers. Stat., 43, pp. 223–238; Chem. Ztg., 17 (1893), pp. 757, 758, and Arch. Hyg., 18, pp. 1–34; abs. in E. S. R., vol. v, pp. 247, 814.

[2] Abs. in Milch Ztg., 22 (1893), pp. 523, 524.

[3] Abs. in Centbl. Bakt. und Par., 14, p. 398, and Chem. Centbl., 1894, I, p. 164.

[4] Veröffentl. Gesundheitsamte, 1892; abs. in Milch Ztg., 21 (1892), p. 644, and Molk. Ztg., 6 (1892), p. 493.

[5] Ztschr. Nahr. Untersuch. und Hyg., 7, p. 3; abs. in Chem. Centbl., 1893, I, p. 396.

[6] Chem. Ztg., 16 (1892), pp. 791, 792; abs. in E. S. R., vol. IV, p. 214.

water by whirling, and the residue examined under a microscope, being stained with fuchsine and with methylene blue containing sulphuric acid,

J. Forster and C. de Man[1] found that tuberculosis bacilli were killed in four hours at 55° C., in one hour at 60°, in fifteen minutes at 65°, in ten minutes at 70°, in five minutes at 80°, in two minutes at 90°, and in one minute at 95°. Heating at 55° for three hours, while not sufficient to kill the bacilli, weakened the tuberculosis virus. Heating milk at 65° for fifteen minutes or at 70° for ten minutes is recommended.

R. Ostertag[2] holds that feeding in an uncooked condition the sediment from milk separators to swine results in the spread of tuberculosis among animals, and should be investigated.

In an article on tuberculosis in relation to animal industry and public health, James Law[3] considers the danger of infection from consuming the milk of tuberculous animals and concludes that such milk is unfit for food. He states that while sterilization does away with the possibility of infection it does not restore the milk to a nonpoisonous condition, and hence does not render it innocuous.

A. C. Abbott[4] inoculated two cows with cultures of the germs of diphtheria. In neither case did an eruption appear upon the udder or teats, nor was *Bacillus diphtheriæ* found in the milk, although this germ was present in large numbers in the tissues of the animals. These results do not agree with those of Klein,[5] who observed an eruption on the udder and found the bacillus in the milk of cows on the fifth day after inoculation.

From experiments on the curdling of milk by cholera bacilli J. de Haan and A. C. Huysse[6] are led to conclude that this is due to the production of lactic acid from the milk sugar. They isolated an enzyme from the sour milk, but this did not have the power to curdle casein or milk, although it liquefied gelatin.

At a meeting of the German Dairy Association[7] Mehrdorf, Weigmann, Neuhauss, Schuppan, and others spoke of the danger of the spread of contagious diseases through milk and dairy products. They reviewed the status of this question and made suggestions for reducing the danger. The same subject has been discussed by St. Friis.[8] Scala and Alessi[9] have considered the transmission of disease by artificial butter.

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[1] Milch Ztg., 23 (1894), pp. 84, 85, and Arch. Hyg., 18, pp. 133-179.

[2] Ztschr. Fleisch- und Milchhyg., 1893, Oct.; abs. in Milch Ztg., 22 (1893), p. 672.

[3] N. Y. Cornell Sta. Bul. No. 65.

[4] Jour. Path. Bac., 2 (1893), pp. 35-51.

[5] Nineteenth Annual Report Local Govt. Board, Sup. Rep. of Medical Officer, 1889-'90.

[6] Centbl. Bakt. und Par., 15 (1894), p. 268.

[7] Molk. Ztg., 7 (1893), pp. 84-96; abs. in Vierteljahr. Chem. Nahr. und Genussmtl., 8 (1893), p. 8.

[8] Hyg. Rundsch.; abs. in Milch Ztg., 22 (1893), No. 30, and Vierteljahr. Chem. Nahr. und Genussmtl., 8 (1893), p. 216.

[9] Atti. R. Acad. med. Roma, 1891; abs. in Ztschr. Nahr. Untersuch. und Hyg., 6, p. 24.

L. H. Pammel[1] gives the number of microörganisms found in cheese, curd, whey, buttermilk, and butter, mentioning the species in some cases. V. von Klecki[2] describes five forms of anaërobic bacteria which he isolated from rancid butter. He has shown that the souring of butter is principally due to bacteria. Duclaux and Ritsert have shown that microörganisms can not decompose pure fat. The author and also Krüger have shown that in butter bactëria occur which can cause acidity by decomposing milk sugar. The question is, Can the microörganisms in natural butter (not pure butter fat) produce acid out of the fat?

V. Malenchini[3] believes that the ptomaines in cheese are of bacterial origin, but thinks that several forms of bacteria besides Deneke's *Spirillum tyrogenum* can render cheese poisonous. Freshly made cheese may be rendered poisonous from changes which have already taken place in the milk.

E. Duclaux[4] considers the saponification and oxidation processes in cheese, their causes, and the relation of bacteria to them. He believes both processes are caused by microörganisms. If cheese is broken up so as to give free access of air, both processes go on simultaneously. In the ordinary ripening of cheese oxidation is confined to the rind and protects the interior of the cheese from saponification by forming a layer excluding the oxygen.

According to Richert[5] metallic salts can be divided into three groups with respect to their effect in retarding the fermentations of milk, as follows: (1) Na, K, Li, Mg, Ca, Sr, and Ba; (2) Fe, Mn, Pb, Zn, Ur, and Al; and (3) Cu, Hg, Au, Pt, Cd, Co, and Ni, the latter class being the most powerful. In general the rarer metals are more powerful than the more common ones to which the organisms are accustomed.

Weigmann[6] intimates that in Norway and Sweden milk for domestic use is frequently preserved with boracic acid, but J. Sebelien[7] denies this statement so far as Norway is concerned.

Carbonic acid was found by Nourry and Michel[8] to delay the souring of milk. Milk charged with carbonic acid kept a week at ordinary temperature. Krüger[9] has discussed at length the importance of antiseptics in dairying.

At a meeting of the German Dairy Association, Schuppan[10] recommended the use of sand filters for removing dirt and germs from milk.

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[1] Iowa Sta. Bul. No. 21; abs. in E. S. R., vol. v, p. 208.

[2] Centbl. Bakt. und Par., 15 (1894), pp. 354–362.

[3] Ztschr. Nahr. Untersuch. und Hyg., 7, p. 7; abs. in Chem. Centbl., 1893, I, p. 397.

[4] Ann. Inst. Pasteur, 7 (1893), pp. 305–324.

[5] Compt. Rend., 117 (1893), pp. 673–676; abs. in Molk. Ztg., 7 (1893), p. 497.

[6] Die Methoden der Milchconservierung, p. 12.

[7] Chem. Ztg., 17 (1893), p. 544.

[8] Compt. Rend., 115 (1892), p. 959.

[9] Molk. Ztg., 6 (1892), pp. 413, 425, 439, 451, 460.

[10] Ibid., 7 (1893), p. 241; abs. in Vierteljahr. Chem. Nahr. und Genussmtl., 8 (1893), p. 6.

He describes the manner of preparing the sand filter, and states that the fat content is not materially changed by filtering through sand. Sand filters are used in Copenhagen which filter 5,000 liters of milk per hour. From other sides the use of sand filters has been questioned.

With reference to the germ content of human milk, H. Knockenstiern[1] found that even when the breasts were treated with corrosive sublimate solution the milk drawn contained germs, one or two forms of bacteria occurring most frequently. F. Honigmann[2] found a number of forms of bacteria in the milk of a large number of healthy women. Human milk was not a germicide for the germs of a number of common contagious diseases. In studying this subject T. Ringel[3] found, in agreement with Cohn and Neumann, Honigmann, and others, that human milk nearly always (in 23 out of 25 cases) contained *Staphylococcen.* Two other forms occur frequently. These germs, he believes, work their way into the glands of the breast, but do not cause trouble there.

Rennet.—The production of rennet artificially has been studied by H. W. Conn.[4] He isolated and grew a large number of bacteria, which in milk produced a ferment resembling rennet in every way. The ferment can be isolated from bacteria cultures by filtering through a porcelain cylinder and then treating with alcohol or, better, with an excess of salt. Precipitation with salt gives the purer product. It has not been possible to isolate a rennet which would curdle milk without souring it also.

F. Baumann[5] found freshly prepared rennet extract to contain 1,500,000 germs to the cubic centimeter. It was sterilized by heating to 58.5° C. for four and one half hours on six consecutive days. By this treatment the rennet lost about 43.5 per cent of its strength. The author believes that the bacteria in rennet are of less importance in the fermentation and ripening of cheese than is usually believed. L. H. Pammel[6] found in rennet all the way from 409,500 to 4,019,200 germs per cubic centimeter. Anaërobic bacteria predominated, but these developed more slowly than the aërobic. The anaërobe most common was a micrococcus growing in chains, producing white lens-shaped colonies. An aërobic yeast was also present. The author is "inclined to think that the bacteria in rennet are not as important in ripening cheese as the bacteria found in milk."

From a study of commercial rennet extracts G. E. Patrick[7] finds "wide differences in composition and in coagulating power" and recommends that cheese-makers select their rennet extract by a test of curdling power. He details two methods for making the test.

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[1]Inaugural Dissertation, Dorpat, 1893; abs. in Chem. Centbl., 1893, II, p. 62.

[2]Ztschr. Hyg., 14, pp. 207-248; abs. in Chem. Centbl., 1893, II, p. 217.

[3]Münch. med. Wochenschr., 40, pp. 513-517; abs. in Chem. Centbl., 1893, II, p. 695.

[4]Conn. Storrs. Sta. Report for 1892, p. 106; abs. in E. S. R., vol. V, p. 563.

[5]Landw. Vers. Stat., 42, p. 181; abs. in E. S. R., vol. V, p. 249.

[6]Iowa Sta. Bul. No. 21; abs. in E. S. R., vol. V, p. 208.

[7]Ibid., No. 22; abs. in E. S. R., vol. V, p. 1001.

J. R. Green[1] mentions a number of plants and fruits yielding rennet, and describes means of extracting the ferment. In some cases these vegetable rennets have been used in cheese-making instead of the animal product.

(Further contributions on dairy bacteriology are cited in the following chapter and under butter-making and cheese-making.)

STERILIZING AND PASTEURIZING MILK.

The term sterilizing in its strictest sense refers to the heating of milk until it is rendered absolutely free from virulent germs or spores; and is effected by heating the milk at the boiling point on several successive days, meantime keeping it either hermetically sealed or closed with a plug of cotton to exclude the germs in the air.

Pasteurizing, originally applied to the treatment of wines, refers to the heating of milk at a much lower temperature, usually about 65–70° C., or 150–155° F., and while it does not render the milk sterile it is supposed to largely destroy the pathogenic germs. It is more often employed in the household than sterilizing because it is simpler and because the nature and digestibility of the milk are not changed as in sterilizing, as mentioned above. Loosely used, the term sterilizing is coming to include pasteurizing, at least in the popular mind. In view of the wide difference between the two kinds of treatment and their effect upon the character and the keeping qualities of the milk, it seems desirable that the terms should be used only in their strict sense.

Experiments in pasteurization by H. P. Lunde[2] led to the following conclusions: (1) The keeping quality of separator skim milk is only slightly improved by pasteurization unless followed by rapid cooling; (2) the keeping quality of pasteurized milk suffers especially if allowed to remain at a temperature between 30° and 50° C.; and (3) pasteurization at 70–75° followed by rapid cooling to 25° or lower greatly increases the keeping quality of milk.

Popp and Becker[3] found the germ content per cubic centimeter of whole milk to be 72,954; of the cream of this milk, 58,275; the separator skim milk, 21,735; and the separator sediment, 43,891. When pasteurized the skim milk contained 1,070 germs and the cream 1,170; while the sterilized skim milk and cream were germ free. F. Baumann,[4] observed that heating ordinary market milk which contained large numbers of bacteria for two hours at 70° C. killed about 99.5 per cent of the germs but took away its power to "cheese."

M. Bleisch[5] compared sterilizing milk by heating in bottles closed

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[1] Bot. Centbl., 1893, II, p. 86.

[2] Beretning fra. den Kgl. Vet. Landt. Lab. Landökon. Forsög., Copenhagen, 1891; abs. in Centbl. Agr. Chem., 21, pp. 621–628, and E. S. R., vol. IV, p. 383.

[3] Hyg. Rundsch., 3, pp. 530–534; abs. in Chem. Centbl., 1893, II, p. 768, and E. S. R., vol. V, p. 646.

[4] Landw. Vers. Stat., 42, p 181; abs. in E. S. R., vol. V, p. 249.

[5] Ztschr. Hyg., 13, pp. 81–99; abs. in Chem. Centbl., 1893, I, p. 434.

with cotton and in bottles heremetically sealed, heating both by steam for two and one half hours. The milk heated in air-tight bottles kept longer than the other, probably, it is believed, because the exclusion of oxygen prevented the growth of microörganisms.

N. Auerbach[1] has found that pasteurizing milk by Soxhlet's method does not always make it fit for infants. Grass and new hay contain bacteria which decompose the milk, forming butyric acid. These bacteria get into the milk from the food or the manure, as they pass the animal without being injured. In six weeks the bacteria on new hay die if allowed to dry up, and after that the hay is like old hay in its action. The products of the action of these bacteria are believed to be injurious to infants, and hence the feeding of dry food is regarded as safer.

It is frequently stated that the change in milk affecting its taste begins at a temperature of about 68° C. C. de Man[2] found that heating milk in a water bath at 70° C. for ten minutes did not impart any taste to it; it could not be distinguished from fresh milk not heated. In ordinary practice he believes that portions of the milk are heated above this temperature and affect the whole quantity.

Hesse[3] examined milk sterilized on a large scale by steam. He found that to obtain a milk which would keep well the steam must be allowed to act for at least one and one half hours.

In sterilizing milk for infants, Aufrecht[4] recommends the use of Soxhlet's apparatus, but suggests closing the bottles with cotton instead of with the regulation rubber cover; using distilled water for diluting the milk; and sterilizing the milk in the stable as soon as milked.

The bitter taste often resulting from boiling milk is found by Hueppe[5] to be due to the action of a ferment given out by the bacteria, which, it is said, peptonizes the casein. The bitter taste is attributed to the formation of casein-peptone.

As is well-known, the fat in sterilized milk gradually rises on keeping. Renk[6] determined the extent to which this occurred in keeping milk sterilized by Soxhlet's method, and recommends that for infants' use milk should not be sterilized in large quantity, but only a little at a time as needed.

Methods of sterilizing and pasteurizing milk.—A number of methods and apparatus for sterilizing and pasteurizing milk have recently been described. In Dr. Bitter's pasteurizing apparatus[7] the milk is heated

[1] Milch Ztg., 22 (1893), pp. 490, 491, 506–508.

[2] Arch. Hyg., 18, p. 167.

[3] Ztschr. Hyg., 13, pp. 42–48; abs. in Chem. Centbl., 1893, I, p. 397.

[4] Deut. med. Wochenschr., 1893, No. 51; abs. in Vierteljahr. Chem. Nahr. und Genussmtl., 8 (1893), p. 104.

[5] Abs. in Vierteljahr. Chem. Nahr. und Genussmtl., 7 (1892), p. 404.

[6] Arch. Hyg., 17, pp. 312–323; abs. in Chem. Centbl., 1893, II, p. 695, and E. S. R., vol. V, p. 264.

[7] Ztschr. Hyg., 8, p. 240.

in an upright boiler of 50 to 100 liters capacity by means of a system of steam pipes within the boiler. A stirring apparatus is provided to keep the milk from burning on to the steam pipes.

The apparatus of Neuhauss, Gronwald, and Oehlmann[1] is built in sizes for sterilizing from 50 to 238 bottles at a time. The milk is heated in bottles provided with a vent to 85–90° C. by means of steam for thirty minutes, when the bottles are allowed to cool for some hours and then heated again to 102° or 103° C. for thirty minutes and the bottles all hermetically closed at once by means of a mechanical contrivance.

Kleemann's apparatus[2] consists of an upright boiler, with a system of steam pipes and a stirring apparatus, through which a stream of milk is run continuously. The milk enters at the bottom and overflows through a pipe at the top of the apparatus.

Legay's milk "sterilizator"[3] consists of a vessel of from a pint to a quart capacity, into the neck of which a glass tube, closed at one end, is fastened air-tight by means of rubber rings. The milk is heated in this apparatus until it rises to a certain height in the tube, when the heat is removed, and it is allowed to stand from ten to twenty minutes and then rapidly cooled. Milk pasteurized in this manner is said to remain sweet for three or four days.

C. A. Cary[4] proposes to sterilize milk or water by heating in hermetically sealed glass bottles, the bottles being closed by a stopper similar to that of a beer bottle. He describes a simple apparatus for home use.

R. Rempel[5] has patented a new device for sterilizing milk, fruit, vegetables, etc. The apparatus is closed when the sterilizing is ended by the pressure of the outer air against the rubber-faced cap.

C. Fränkel[6] has described a stopper with vent for closing the bottles, which was first proposed and used by Popp and Becker. The bottles are closed during sterilizing, except that the vent is left open. After sterilizing this is closed.

K. Flaach[7] has described an apparatus designed by himself which he claims gives milk from which the fat does not separate into globules; the cream can be easily mixed with the milk after standing for months. A simple apparatus for home use, similar to Soxhlet's apparatus, has been described by the Bureau of Animal Industry of this Department.[8]

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[1] Jour. Soc. Chem. Ind., 12 (1893), p. 615, and Fleischmann's Lehrbuch der Milchwirthschaft, p. 256.

[2] Landw. Ann. meckl. pat. Ver., 1893, pp. 393–398, and Molk. Ztg., 8 (1894), pp. 173, 174.

[3] Milch Ztg., 22 (1893), p. 360; abs. in E. S. R., vol. v, p. 265.

[4] Ala. College Sta. Bul. No. 53; abs. in E. S. R., vol. v, p. 897.

[5] Ztschr. angew. Chem., 1894, p. 131.

[6] Hyg. Rundsch., 7, pp. 621–626; abs. in Chem. Centbl., 1893, II, p. 868, and Molk. Ztg., 7 (1893), p. 437.

[7] Milch Ztg., 22 (1893), pp. 119–122, 140–143.

[8] Circular, Dec. 19, 1893.

A. Stutzer[1] has described a method in which the rubber plate, used in closing the bottle in Soxhlet's method, is replaced by a rubber cap with a vent which closes tightly as the liquid cools. Schulz[2] has also described a stopper for this purpose. In form the stopper is a hollow rubber cone, with walls sufficiently thick to make it fit tightly into the neck of the bottle and hermetically close it as the milk cools.

The sterilization of milk by means of electricity has been discussed by A. J. Boult[3] and by Dubousquet-Laborderie[4]. The latter found that an interrupted current had no effect in preserving milk, but that with a continuous current, electrolysis of the milk took place. The germs in treated milk were killed, but the temperature of 80–100° C. brought about by the treatment was sufficient to account for this.

BUTTER-MAKING.

In general.—A comparison of Jersey, Guernsey, Holstein, Ayrshire, Devon, and American Holderness breeds, with reference to production of butter in the first and second periods of lactation, is given by L. L. Van Slyke[5]. In the first period of lactation the Guernseys, closely followed by the Jerseys, gave the largest daily yield of butter. The average amount of butter made from 1 pound of fat in the milk was: Guernseys, 1.07; Jerseys, 1.04; Holdernesses, 0.98; Devons, 0.97; Ayrshires, 0.93; and Holsteins, 0.88 pounds.

As to the effect of the stage of lactation on butter-making, J. W. Robertson[6] found that in deep-setting the loss of fat in the skim milk amounted to 31.11 per cent with cows eight to eleven months in milk, 27.35 per cent with cows five to eight months in milk, and 15.96 per cent with cows one to three months in milk. The cream from the cows five to eleven months in milk required a longer time for churning, but the loss of fat in the buttermilk was nearly the same for the three stages. In a later experiment the same author[7] found that with cows more than six and one half months in milk the loss of fat in creaming by separator or deep-setting was greater and the butter was poorer than in the case of cows milked less than that time. The creaming of the milk of older cows in deep-setting was much improved by mixing it with the milk of a fresh cow.

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[1] Ztschr. angew. Chem., 1894, pp. 130, 131, and Deut. landw. Presse, 21 (1894), pp. 365, 379.

[2] Ztschr. Nahr. Untersuch. und Hyg., 1893, No. 21; abs. in Ztschr. Fleisch- und Milchhyg., 1894, p. 73.

[3] Jour. Soc. Chem. Ind., 12 (1893), p. 616.

[4] Abs. in Milch Ztg., 21 (1892), p. 473.

[5] N. Y. State Sta. Report for 1891, pp. 299–369, and Report for 1892, pp. 467–494; abs. in E. S. R., vol. IV, p. 268.

[6] Canada Experimental Farms Report for 1891, pp. 91, 96; abs. in E. S. R., vol IV. pp. 445, 446.

[7] Ibid., 1892, pp. 74–76; abs. in E. S. R., vol. V, p. 641.

L. L. Van Slyke[1] found in the case of the milk of different breeds that the percentage of fat was usually larger in the first month of lactation. Generally the loss of fat in skim milk increased as lactation advanced, due to the globules becoming smaller. Milk richest in fat appeared to be least affected in this respect. The loss of fat in the buttermilk appeared to be independent of the stage of lactation. The milk yield was generally largest in the second or third month and the same was true of the fat yield. An increase in both temperature and length of time for churning was usually required as lactation advanced.

Experiments in working water into butter were made by F. Friis.[2] He found that nearly a pound of water could be worked into 25 pounds of butter after it was made. This lowered the grade and the keeping quality of the butter. Butter worked only once contained nearly 0.5 per cent more water than that worked several times. The longer the interval between salting and the last working the less water was found in the butter. Neither the quantity nor the quality of the butter was much changed by working water into it during its manufacture. It is said that the adulteration of butter with water would not pay.

Jacobson[3] reports on the effect of water on butter, and another[4] mentions the injurious effect of iron on the taste and smell of butter. Weigmann[5] has already attributed oily butter to iron, which came about from the use of poorly tinned vessels in creaming.

Experiments in salting butter are given by W. S. Sweetser and R. J. Weld.[6] Salting with $\frac{1}{2}$ to $1\frac{1}{2}$ ounces of salt per pound increased the total weight of worked butter about 12 per cent over no salting. The unsalted butter had a larger water content than the salted. Salting with brine was not effectual, as "practically none of the salt was retained."

In a bulletin on nostrums for increasing the yield of butter, H. W. Wiley[7] exposes such frauds as "black pepsin," "gilt-edge butter compound," and similar materials, which have been quite extensively advertised for increasing the yield of butter.

From experiments made by J. Seidl[8] in preserving butter in brine, it appears that a weak brine, at least up to 10 per cent, is not fitted for keeping butter for a long period, and that even saturated brine can not be absolutely relied upon for this purpose, even when the butter

[1] N. Y. State Sta. Report for 1891, pp. 369–386; abs. in E. S. R., vol. IV, p. 271.

[2] Kgl. Vet. Landt. Lab. Landökon. Forsög., 28th Report, 1893; abs. in E. S. R., vol. V, p. 723.

[3] Deut. Molk. Ztg., 2 (1892), p. 155.

[4] Ibid., p. 442.

[5] Milch Ztg., 20 (1891), p. 1019.

[6] Agr. Science, 7 (1893), pp. 546–548.

[7] U. S. Department of Agriculture, Farmers' Bul. No. 12; abs. in E. S. R., vol. V, p. 218.

[8] Milch Ztg., 21 (1892), pp. 577, 578; abs. in Vierteljahr. Chem. Nahr. und. Genussmtl., 7 (1892), p. 273.

is kept in a cold place. Butter kept in 10 per cent brine had a strong "beet" taste.

The losses in butter-making at a creamery were studied by W. W. Cooke and J. L. Hills.[1] Averaging the results of twenty-two days, the percentage of fat in the separator skim milk was 0.19 and in the buttermilk 0.6. This was equivalent to a daily loss of 11.6 pounds of fat in the skim milk and 10.3 pounds in the buttermilk. On an average 92.5 per cent of the fat in the whole milk was recovered in the butter; on the best day 96 per cent was recovered. On another occasion the same authors[2] found that the amount of butter made for each 100 pounds of butter fat in the milk ranged for thirty-two days between 104.4 and 115.6 pounds, averaging 110.1 pounds. "The best of work should yield fully 15 per cent more butter than butter fat, though this result would be obtained but rarely in creamery work."

L. L. Van Slyke[3] considers the method of estimating the butter-making efficiency of milk fat, and concludes that this can only be done with accuracy for a given set of conditions of creaming, churning, and treatment of the butter.

As between butter made by H. H. Dean[4] from aërated and nonaërated milk, after keeping about two months "there was no difference in the quality of the butter as far as we could tell."

Tests of various dairy apparatus, including milk coolers and aërators, are reported by H. P. Armsby, H. J. Waters, W. H. Caldwell,[5] H. H. Wing,[6] and Theunis.[7] A practical discussion of the requirements necessary to the production of first-quality butter in coöperative creameries is given by Du Roi.[8]

Creaming milk.—P. Collier[9] illustrates the rapidity of the movement of fat globules in cream-raising, and shows the difference in time required for creaming Jersey and Ayrshire milk, owing to the difference in size of the globules. From a lengthy consideration of the effect of the size of the globules on creaming and churning, F. W. Woll[10] concludes that "large size in the fat globules facilitates both the creaming and the churning of the milk; but the size of the globules is only one of the factors influencing the completeness of creaming and churning processes." By mixing milks containing globules of different sizes "the creaming efficiency does not seem to be materially affected."

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[1] Vt. Sta. Report for 1891, p. 69; abs. in E. S. R., vol. IV, p. 491.

[2] Ibid., p. 73; abs. in E. S. R., vol. IV, p. 492.

[3] N. Y. State Sta. Report for 1891, pp. 389–391; abs. in E. S. R., vol. IV, p. 273.

[4] Ontario Agr. College and Exptl. Farm Report for 1892, p. 220; abs. in E. S. R., vol. V, p. 643.

[5] Penn. Sta. Bul. No. 20; abs. in E. S. R., vol. IV, p. 364.

[6] N. Y. Cornell Sta. Bul. No. 39; abs. in E. S. R., vol. IV, p. 363.

[7] Bul. Agr. (Belgium), 9 (1893), pp. 97–131.

[8] Molk. Ztg., 7 (1893), pp. 253, 254.

[9] N. Y. State Sta. Report for 1891, p. 155; abs. in E. S. R., vol. IV, p. 265.

[10] Agr. Science, 6 (1892), p. 545.

L. L. Van Slyke[1] compared the Baby separator and cold deep-setting on the milk of 10 cows for one month. The percentage of the fat recovered in the butter was 70.2 with deep-setting and 93 with the separator. The same author[2] compared the separator and deep-setting in creaming the milk of six different breeds, showing that "in the case of every breed the separator gives better results in yield of butter. The increased yield was greater with the Holsteins and second with the Ayrshires." He calculates that the saving would pay for a separator in a year with a herd of 6 or 7 Holsteins, 12 Ayrshires, 16 Devons, 18 Holdernesses or Jerseys, or 24 Guernseys.

H. H. Wing[3] reports a number of trials with the De Laval horizontal separator, the Baby separator No. 2, and deep-setting. The skim milk from the horizontal separator contained 0.19, from the Baby separator 0.09, and from deep-setting 0.23 per cent of fat.

W. H. Jordan[4] has studied the thoroughness of creaming in deep-setting on 224 farms in Maine. On 165 of these the fat in the skim milk did not exceed 0.2 per cent, and averaged about 0.15 per cent. According to this the use of a separator would only save about 1 pound of butter to 200 pounds of skim milk. The Connecticut State Station[5] found that the separator creamed the milk more effectually than deep-setting. In the skim milk from 1,000 pounds of whole milk deep-setting left 177 to 335 pounds of fat, while the separator left 0.65 to 1.65 pounds. The quality of the butter was equally good under both systems.

H. H. Dean[6] found that 45° F. or below was the best temperature for creaming in deep-setting. Delaying setting slightly impaired the efficiency of creaming. No advantage was apparent from heating the milk to 93–110° F. before setting. In ten trials the addition of 10 to 25 per cent of warm water appeared to very slightly improve the thoroughness of creaming. The same author[7] reports short experiments in creaming milk in deep-setting and in shallow pans set in the air, in warm water and in cold water. Additional experiments on cream-raising by dilution have been reported by H. H. Wing,[8] W. W. Cooke,[9] and J. W. Robertson.[10]

The effect of delaying the setting has been observed by J. W. Rob-

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[1] N. Y. State Sta. Report for 1891, pp. 391, 392; abs. in E. S. R., vol. IV, p. 273.

[2] Ibid., 1892, p. 469.

[3] N. Y. Cornell Sta. Bul. No. 39; abs. in E. S. R., vol. IV, p. 363.

[4] Maine Sta. Bul. No. 5 (n. ser.); abs. in E. S. R., vol. V, p. 999.

[5] Conn. State Sta. Report for 1893, pp. 163–170; abs. in E. S. R., vol. V, p. 998.

[6] Ontario Agr. College and Exptl. Farm Report for 1892, pp. 219, 220; abs. in E. S. R., vol. V, p. 643.

[7] Ibid., 1893, pp. 140–144.

[8] N. Y. Cornell Sta. Bul. No. 39; abs. in E. S. R., vol. IV, p. 361.

[9] Vt. Sta. Report for 1891, pp. 103, 104; abs. in E. S. R., vol. IV, p. 489.

[10] Canada Exptl. Farms Report for 1891, p. 91; abs. in E. S. R., vol. IV, p. 445.

ertson[1] and H. H. Dean.[2] The former found a loss of about 11.5 per cent more of fat from delaying the setting one hour, but the latter observed little effect from delay as long as the milk was cooled to about 40° F. before skimming.

As to the effect of scalding milk before setting it in deep cans in ice water, J. W. Robertson[3] found that it resulted in a greater loss of fat and gave butter which was inferior in flavor and odor to that set without heating. The same author[4] found that setting in deep cans in ice water for twenty-four hours was better than eleven hours.

Tests of various hand and power separators have been reported by C. L. Penny,[5] H. H. Wing,[6] J. Klein, and M. Kühn,[7] and Zecher.[8] Gieseler[9] gives a method for calculating the efficiency of milk separators, and C. L. Penny[10] a method for estimating the power required to run separators.

Churning.—When cream was diluted with water before souring, J. W. Robertson[11] found that a longer time was required for churning, the loss of fat was slightly greater, and the butter was not as firm or solid.

U. W. Massalsky[12] proposes to mix separator cream with an equal amount of hot water, run the mixture through the separator again, and then churn the cream thus separated. He claims that in this way a purer fat is obtained, nearly free from casein and other fat-free materials, and that as a result the butter is more quickly churned and keeps longer. In comparisons at the Connecticut State Station[13] of churning cream raised by separator and by the Cooley system there was a greater loss of fat with the separator cream, and mixing the two kinds of cream did not diminish this loss.

From some 40 trials in churning sweet cream at different temperatures, J. W. Robertson[14] concludes that the temperature of the cream should not be above 50° F. when the churning is started, and the churn, if a revolving one, should not be filled more than one fourth full.

In comparisons of sweet *vs.* sour cream for butter, G. E. Patrick, F. A.

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[1] Canada Exptl. Farms Report for 1891, pp. 89, 90; abs. in E. S. R., vol. IV, p. 445.

[2] Ontario Agr. College and Exptl. Farm Report for 1891, p. 181; abs. in E. S. R., vol. V, p. 643.

[3] Ibid., p. 101; abs. in E. S. R., vol. IV, p. 447.

[4] Ibid., p. 90; abs. in E. S. R., vol. IV, p. 445.

[5] Del. Sta. Bul., No. 17, and Report for 1892, pp. 110–123; abs. in E. S. R., vol. IV, p. 188, and in vol. V, p. 796.

[6] N. Y. Cornell Sta. Bul. No. 39; abs. in E. S. R., vol. IV, p. 362.

[7] Centbl. agr. Chem., 22, pp. 47–49.

[8] Ztschr. landw. Cent. Ver. Sachsen, 1892, pp. 427–430.

[9] Landw. Jahrb., 22, pp. 569–580, and Milch Ztg., 22 (1893), pp. 303, 304.

[10] Del. Sta. Report for 1892, p. 110.

[11] Canada Exptl. Farms Report for 1892, pp. 77, 78; abs. in E. S. R., vol. V, p. 642.

[12] La Laitière, 1893, No. 12; abs. in E. S. R., vol. V, p. 827.

[13] Conn. State Sta. Report for 1893, pp. 147–163.

[14] Canada Exptl. Farms Report for 1892, p. 76; abs. in E. S. R., vol. V, p. 641.

Layton, and D. B. Bisbee[1] found that the sour cream averaged about 3 per cent more butter, churned quicker, and gave butter which had a better color, less fat, and more water, but did not keep as well in the five months' test as that from sweet cream. The loss of fat in churning and working the sweet-cream butter was about 50 per cent greater than with sour cream. In another series of experiments G. E. Patrick, F. A. Layton, and W. H. Heileman[2] found that when kept for about six months at a temperature of about 50° F. the sweet-cream butter suffered less deterioration than the ripened-cream butter, and in some measure acquired the flavor characteristic of the latter.

In experiments by J. W. Robertson[3] the sweet cream required to be churned longer and gave a smaller yield of butter than the sour cream, the loss in the buttermilk being greater. The same result was observed by H. H. Dean,[4] who also found that after keeping for three or four weeks the sweet-cream butter was off flavor and of inferior quality to the ripened-cream butter. The same author[5] observed that the loss of fat in the buttermilk in churning sweet cream was excessive when the temperature of churning was above 52–54° F. After keeping the sweet-cream butter a week it showed signs of spoiling.

W. H. Caldwell[6] reports trials with the extractor-separator, in which the cream is churned immediately after separation. The apparatus recovered, on an average, 89.34 pounds of butter fat for every 100 pounds of fat in the milk. The butter lacked body and contained a large percentage of water. It had the flavor of sweet-cream butter.

As to the effect of the acidity of the cream on its churnability, H. C. Wallace[7] reports a number of trials, the result of which "seems to indicate that the acidity of the cream bears a decided relation to the loss of fat in churning," an acidity requiring between 34 and 40 c. c. of acid to neutralize 50 c. c. of cream, giving more favorable results than a lower or higher one. For determining the acidity of cream in practice, E. H. Farrington[8] has worked out a formula for alkaline tablets containing a definite amount of solid alkali and indicator. The number of these required to neutralize 25 c. c. of cream gives an approximate idea of its acidity.

Pure cultures in ripening cream.—The principles and the use of pure cultures in ripening cream have been described by H. W. Conn.[9] The

[1] Iowa Sta. Bul. No. 18; abs. in E. S. R., vol. IV, p. 425.

[2] Ibid., 21; abs. in E. S. R., vol. V, p. 207.

[3] Canada Exptl. Farms Report for 1891, p. 100; abs. in E. S. R., vol. IV, p. 446.

[4] Ontario Agr. College and Exptl. Farm Report for 1892, p. 221; abs. in E. S. R., vol. V, p. 643.

[5] Ibid., 1891, pp. 179–181; abs. in E. S. R., vol. V, p. 646.

[6] Penn. Sta. Bul. No. 22; abs. in E. S. R., vol. IV, p. 751.

[7] Iowa Sta. Bul. No. 22; abs. in E. S. R., vol. V, p. 1000.

[8] Ill. Sta. Bul. No. 32.

[9] U. S. Department of Agriculture, Experiment Station Bul. No. 9; abs. in E. S. R., vol. IV, p. 201.

same author[1] mentions a study of the organisms found in ripening cream in this country. He concludes that "the lactic organism described by Hueppe (*Bacillus acidi lactici*) is, at all events, not common in the vicinity of Middletown [Conn.]."

In a later article[2] he reports experiments with the use of pure cultures at a creamery. The quality of the butter improved as soon as the pure cultures were used, and a butter closely resembling June butter was produced in January. According to expert judges, the cultures improved the quality of the butter by more than 20 per cent. The species of bacteria used in these cultures was one isolated from "preserved milk" from Uruguay, exhibited at the World's Fair. Better butter was produced with this organism than with any other species yet found. H. Weigmann[3] reports favorable results from the use of pure cultures, especially in correcting defects in butter. For one and one half years the use of pure cultures has not failed to correct any fault in butter, as oiliness, fishy, bitter, or beet taste, tendency to become rancid, or poor keeping quality. The author does not favor pasteurizing the cream, but rather the use of pure cultures. The Kiel Experiment Station[4] mentions finding a bacteria in butter which produced an odor and taste in milk similar to that of roots. Butter made with the use of this bacteria acquired the root taste in about two weeks, which increased as the butter aged. Other papers on pure cultures, mostly popular, have been published by F. Lafar[5] and by Klein and Kühn.[6]

E. A. de Schweinitz[7] suggests that, as the flavor, aroma, and desirable qualities of good butter are undoubtedly due to the production of certain chemical compounds by the bacteria employed, these chemical compounds should be studied and their nature determined with a view of producing them outside the cream. He suggests that the addition of an extract containing these desirable compounds would be preferable to the addition of a mixture of bacteria.

Pasteurizing the milk or cream in butter-making.—The use of pasteurized cream in butter-making has been suggested in place of pure cultures. H. P. Lunde[8] mentions a case in which the butter on a certain farm suddenly became so poor that it could not be marketed. When the cream was pasteurized at 65–70° C., rapidly cooled, and churned sweet, or ripened either with pure cultures or with buttermilk from a good creamery after pasteurizing, butter of excellent quality was produced. Pasteurizing cream at 85° C. gave the butter a cooked

[1] Conn. Storrs. Sta. Report for 1891, p. 172; abs. in E. S. R., vol. IV, p. 75.

[2] Ibid., Bul. No. 12; abs. in E. S. R., vol. V, p. 996.

[3] Milch Ztg., 21 (1892), p. 277.

[4] Molk. Ztg., 7, p. 479; abs. in E. S. R., vol. V, p. 353.

[5] Oesterr. landw. Wochenbl., 1893, pp. 123, 147.

[6] Landbote, 1893, p. 611.

[7] Jour. Amer. Chem. Soc., 16 (1894), p. 265; abs. in E. S. R., vol. V, p. 454.

[8] 22 Beretning Kgl. Vet. Landt. Lab. Landökon. Forsög., Copenhagen, 1891, pp. 67–117; abs. in Centbl. agr. Chem., 21, pp. 554–563, and E. S. R., vol. IV, p. 381.

taste. In other trials on normal milk pasteurizing the milk instead of the cream had little effect on the quality of the butter beyond improving its keeping quality, while pasteurizing cream from the same milk improved the general quality of the butter. About 2 per cent less butter was recovered when the milk or cream was pasteurized.

Popp and Becker[1] found that butter made from pasteurized or sterilized cream contained less germs and kept longer than that made from cream not pasteurized or sterilized. That made from sterilized cream kept the longest. The authors recommend sterilizing the materials used in butter-making. Backhaus[2] has found in actual practice that with the use of milk pasteurized at 70° C. butter of uniformly good quality is obtained. Graeff[3] secures the same end by scalding the milk. Butter made at the Kiel Experiment Station[4] from pasteurized cream was remarkable for its excellent keeping qualities, but it was found difficult in practice to prevent imparting a cooked taste to the butter. Somewhat better results were obtained when the milk was pasteurized before it was separated. Tave Berg[5] compares the losses in making butter from cream pasteurized at 65° C. and from cream not pasteurized. Slightly more fat was lost in the buttermilk from pasteurized cream, and the butter from pasteurized cream contained about 0.5 per cent more water.

J. W. Robertson[6] found that heating cream to 150° F. before ripening prevented a flavor or odor of turnips in the butter when the cows were fed on turnips. When the cream was not heated, the butter had a distinct odor and flavor of turnips.

CHEESE-MAKING.

Extensive investigations have been carried on by the New York State Station.[7] It was found that on an average 50.52 per cent of the total solids, 91.13 of the fat, and 75.72 of the casein and albumen in the milk were recovered in the cheese. The loss of fat in the whey was quite independent of the fat content of the milk. Very little casein was lost, but most of the albumen passed into the whey. As the fat in the milk increased, the yield of green cheese increased, and the quality of the cheese improved. The amount of green cheese made for each pound of fat in the milk averaged 2.72 pounds, and was slightly larger in the case of rich milk.

[1] Hyg. Rundsch., 3, pp. 530–534; abs. in Chem. Centbl., 1893, II, p. 768, and E. S. R., vol. v, p. 646.

[2] Deut. Molk. Ztg., 2 (1892), p. 37; abs. in Molk. Ztg., 7 (1893), p. 352.

[3] Molk. Ztg., 6 (1892), p. 520.

[4] Ibid. 7 (1893), p. 479; abs. in E. S. R., vol. v, p. 353.

[5] Nord. Mejeri Tidn., 9 (1894), p. 126.

[6] Canada Exptl. Farms Report for 1891, p. 102; abs. in E. S. R., vol. IV, p. 447.

[7] N. Y. State Sta. Buls. Nos. 50, 54, 56, 60, 61, 62, 68; abs. in E. S. R., vol. IV, p. 945, vol. v, pp. 85, 211, 603, 605, 609, and 996.

W. W. Cooke and J. L. Hills[1] made cheese from milk containing 3, 4, and 5 per cent of fat, respectively. The two richer milks gave the best cheese and the largest yield. The same authors[2] report on the losses in cheese-making, and the changes in cheese in ripening.

According to experiments by H. C. Wallace[3] with milk containing from 1.75 to 8.4 per cent of fat, the amount of milk required to make 1 pound of cheese steadily decreased as the percentage of fat in the milk increased. The percentage of fat lost did not seem to bear any direct relation to the percentage of fat in the milk, but appeared to depend more on the care and skill exercised in making.

L. L. Van Slyke reports on a comparison of breeds for the production of cheese,[4] and the influence of advancing lactation upon the production of cheese.[5] The data are calculated from the losses observed in experiments in cheese-making. A report on cheese and butter making in the South is given by R. J. Redding and H. J. Wing[6].

The New York State Station[7] describes in detail the method of making Edam and Gouda cheese and reports experiments in making them. B. Rost[8] describes the manufacture of Edam cheese; A. Nentwig[9] describes Emmenthaler, French soft cheese, and Italian Strachini, and the methods for their manufacture; L. Adametz[10] describes the manner of making and the composition of the Bosnian Trappists' cheese; Spica and Blasi[11] give the composition and the manufacture of Sicilian cheeses; *Milch Zeitung*[12] describes Camembert cheese and its method of manufacture; and A. Netwing[13] describes margarin cheese, its nature, and its effect on dairying.

L. L. Van Slyke[14] calculates the probable yield of cheese from milk by multiplying the percentage of fat by 1.1 and the casein by 2.5 and adding the products. "The average difference between the actual and calculated yield of cheese was 0.03 pound for 1 pound of fat in milk." He regards the fat alone as a reliable index to the value of milk for cheese, and as a just basis for the payment for milk at cheese factories.[15]

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[1] Vt. Sta. Report for 1891, pp. 88–95; abs. in E. S. R., vol. IV, p. 492.
[2] Ibid., pp. 95–100; abs. in E. S. R., vol. IV, p. 493.
[3] Iowa Sta. Bul. No. 21; abs. in E. S. R., vol. V, p. 209.
[4] N. Y. State Sta. Report for 1891, pp. 364–369; abs. in E. S. R., vol. IV, p. 273.
[5] Ibid., pp. 387–389; abs. in E. S. R., vol. IV, p. 272.
[6] Ga. Sta. Bul. No. 18; abs. in E. S. R., vol. IV, p. 495.
[7] N. Y. State Sta. Bul. No. 56 (n. ser.); abs. in E. S. R., vol. V, p. 211.
[8] Molk. Ztg., 7 (1893), pp. 309. 310.
[9] Milch Ztg., 22 (1893), pp. 754, 755, 769, 770.
[10] Ibid., 21 (1892), pp. 310–313.
[11] Staz. Sper. Agr. Ital., 23, pp. 133–153; abs. in Molk. Ztg., 7 (1893), p. 707.
[12] Milch Ztg., 23 (1894), p. 121.
[13] Molk. Ztg., 7 (1893), pp. 350, 351.
[14] N. Y. State. Sta. Buls. Nos. 60 and 65; abs. in E. S. R., vol. V, pp. 604, 897.
[15] Ibid., No. 68; abs. in E. S. R., vol. V, p. 996.

Pasteurizing milk, E. von Freudenreich[1] found did not impair its curdling with rennet; the amount of rennet and the time required were the same before and after pasteurizing. He suggests that when we have more definite knowledge of the useful bacteria in the ripening of cheese, pure cultures may be made use of in pasteurized milk, as is now done in butter-making.

C. Basana[2] has shown that the green color in Lombardy cheese was due to setting the milk in copper vessels, and now reports some results in practice on the use of tin vessels.

The development of the Swedish cheese manufacture has been discussed by A. Nathorst,[3] and another[4] has described the Swedish cheese exhibitions at Stockholm.

The ripening of cheese.—L. Adametz[5] gives an excellent résumé on the abnormal ripening of cheese. The list of abnormities includes black cheese, swelling or porous cheese, bitter cheese, and poisonous cheese. He holds that these faults are due to the action of microörganisms, and gives in the case of each a list of the particular organisms which have been found capable of producing the fault, and recommendations for its prevention.

Baumann[6] examined a considerable number of samples of mixed milk and Emmenthaler cheese, and found that all of them contained gas-producing organisms, which bears out his former assertion that all mixed milks contain gas-producing bacteria. When the forms found were isolated and introduced into cheese, they all produced swelling. From a study of the swelling of cheese, F. Baumann[7] concludes that the formation of holes or pores in hard cheese is due principally to the action of a single bacillus, which he calls *Bacillus diatrypeticus casei.* This may render cheese normally or abnormally porous, according to the circumstances. The gas generated consists principally of carbonic acid and hydrogen. Alcohol was also formed. Adametz[8] states that *Bacillus diatrypeticus casei*, mentioned above, is not the only microörganism causing the swelling of cheese, and says that this organism is already well known to many bacteriologists.

E. von Freudenreich[9] has found that salt to a large extent prevents the swelling of cheese. His method of treatment is, after heating the

[1] Schweiz. Milch Ztg.; abs. in Fühling's landw. Ztg., 1893, p. 759.

[2] Staz. Sper. Agr. Ital., 25, pp. 275–279; abs. in Chem. Centbl., 1894, I, p. 647.

[3] Tidskr. Landtmän, 15 (1894), pp. 159–162.

[4] Nord. Mejeri Tidn., 9 (1894), pp. 89, 101, 113, 125.

[5] Milch Ztg., 21 (1892), pp. 205–208, 221–223, and 22 (1883), pp. 187–190, 219, 220, 235–240, 354–357; abs. in Chem. Centbl., 1892, I, p. 897, and 1893, II, pp. 111, 235, and Vierteljarh. Chem. Nahr. und Genussmtl., 6 (1891), p. 25, 7 (1892), p. 23, and 8 (1893), p. 105.

[6] Molk. Ztg., 7 (1893), pp. 649, 650.

[7] Landw. Vers. Stat., 42, pp. 181–214; abs. in E. S. R., vol. IV, p. 249.

[8] Deut. Molk. Ztg., 1893, No. 16; abs. in Chem. Centbl., 1893, II, p. 1019.

[9] Landw. Jahrb. Schweiz., 7 (1893), pp. 81–87; abs. in E. S. R., vol. V, p. 921.

curd, to remove two thirds of the whey and add 3 per cent of salt to the remainder, then treat as usual.

The same author and F. Schaller[1] have studied the ripening of Emmenthaler cheese under the exclusion of air. The cheeses ripened under these conditions were more or less swollen, soft, and bitter. The authors conclude that the ripening process goes on throughout the whole mass simultaneously, and is not a result of the action of enzymes produced by bacteria working on the surface.

Weigmann[2] made Gouda cheese with the use of a pure culture of rennet-producing and peptonizing bacteria, which did not have the taste of Gouda cheese but closely resembled Wilstermarsch cheese. He believes that the characteristic taste and odor, and in fact the general qualities of cheese are generally due to one or more kinds of bacteria, although it is not assumed that the qualities of a cheese are always produced by the same kind of bacteria, for it has been found that different kinds of bacteria, working in the same media, may produce a like result.

L. H. Pammel[3] has observed the effect of peroxide of hydrogen and of salicylic acid on the ripening of cheese. The addition to 100 pounds of milk of 20 c.c. of 2 per cent peroxide of hydrogen had no disinfecting effect and the cheese failed to ripen properly. With two drachms of salicylic acid in the same quantity of milk "the cheese ripened properly." The same author[4] describes an aromatic bacillus (*Bacillus aromaticus*) originally found on cabbage affected with rot, which imparted a peculiar flavor to cheese and caused it to swell.

Additional papers on the ripening of cheese have been contributed by Scala and Jacoangeli[5] and Bochicchio.[6]

H. Winternitz[7] has studied the decomposition products of three kinds of cheese, and H. Jacobsthal[8] reports experiments on the formation of fat during the ripening of cheese. Using white cheese (Quarkkäse) poor in fat, Jacobsthal observed an absolute increase in the amount of fat (ether extract) during ripening. This increase was largely accounted for by the increase in fatty acids and is said to be due to the activity of the fungi cells. The fungi produce neutral fats synthetically from the constituents of the cheese, and later these are saponified, yielding fatty acids. The mold on the surface and interior of cheese and the means of avoiding this in practice is the subject of a study by A. Nentwig.[9]

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[1] Landw. Jahrb. Schweiz., 6 (1892), pp. 62-67, and Schweiz. Wochenschr. Pharm., 31, pp. 78-81; abs. in Chem. Centbl., 1893, I, p. 706.

[2] Molk. Ztg., 7 (1893), p. 479; abs. in E. S. R., vol. v, p. 353.

[3] Iowa Sta. Bul. No. 21; abs. in E. S. R., vol. v, p. 208.

[4] Ibid.

[5] Ann. Inst. d'Igiene di Roma, 2 (1893), p. 135.

[6] L'Agricol. Ind. Agr., 17 (1894), pp. 24-27, 41-44.

[7] Ztschr. physiol. Chem., 16, p. 472.

[8] Arch. ges. Physiol., 54 (1893), pp. 484-500; abs. in E. S. R., vol. v, p. 247.

[9] Molk. Ztg., 7 (1893), pp. 51, 52.

MILK SUPPLY.

In Naples, according to Montefusco,[1] the milk is milked in the street before the houses of the customers, about 1,000 cows, 3,000 goats, and 100 asses being driven through the city for this purpose. The number of tuberculous animals is said to be very small and the milk freer from germs than creamery milk. The number of germs in cows' milk is larger than in goats' or asses' milk. The milk supply of Leipsic and its effect on the health of children is treated of by Plant.[2]

A. Bernstein[3] proposes to transport milk hot, preferably at 70° C., the advantages claimed being that the milk is not affected by heating to this temperature, does not cream during transportation, is rendered practically sterile, and can be transported long distances to large cities. He uses special cars provided with heating apparatus to keep the milk warm. A practical trial of the scheme on an express train between Hamburg and Berlin proved successful, the milk arriving in good condition.

On account of the prevalence of tuberculosis in cattle some of the large coöperative creameries in Germany have decided to require all of the cows of their patrons to be placed under veterinary control, the cows being examined four times a year.[4]

The supervision of the milk trade by the sanitary police has been discussed by H. Schäfer;[5] the cream-collecting creameries in the United States have been described by A. G. Vieth;[6] and the coöperative creameries in western France by Cathelinean and Surcoof.[7]

The payment for milk at creameries on the basis of its fat content has been discussed by R. Kempe,[8] Vieth,[9] and W. Mund;[10] and F. Anderegg[11] and *Milch Zeitung*[12] have discussed this matter in relation to cheese factories. L. L. Van Slyke[13] advocates paying for milk at cheese factories on the basis of its fat content, claiming that the fat content of milk is a true index to its value for cheese-making.

G. E. Patrick[14] takes exception to the statement that the samples

[1] Abs. in Ztschr. Fleisch- und Milchhyg., 4 (1894), p. 74.

[2] Ztschr. Hyg., 15, No. 2; abs. in Ztschr. Fleisch- und Milchhyg., 4 (1894), p. 73.

[3] Molk. Ztg., 7 (1893), pp. 211, 212; and Milch. Ztg., 22 (1893), pp. 259, 342; 23 (1894), pp. 184–186.

[4] E. S. R., vol. IV, p. 318.

[5] Abs. in Molk. Ztg., 6 (1892), p. 415.

[6] Milch Ztg., 21 (1892), pp. 805–807.

[7] Ind. Lait., 18 (1893), pp. 244–246, 252–254.

[8] Molk. Ztg., 6 (1892), pp. 426, 427.

[9] Landw. Vereinsschr. balt. Cent. Ver., 1893, pp. 121–123; and Sächs. landw. Ztschr., 41 (1893), pp. 457, 461.

[10] Molk. Ztg., 6 (1892), pp. 345, 346.

[11] Milch Ztg., 22 (1893), pp. 685, 686.

[12] Ibid., 21 (1892), pp. 689–691.

[13] N. Y. State Sta. Bul. No. 68 (n. ser.); abs. in E. S. R., vol. V, p. 996.

[14] Iowa Sta. Bul. No. 22; abs. in E. S. R., vol. V, p. 1001.

taken daily for the composite sample need not be proportional to the amount of milk delivered. He favors, as a rule, the use of a sampling tube giving a proportionate sample.

As to the frequency of testing the milk when paying for it on the relative value plan, H. Tiemann[1] believes that as a rule regular tests once a week are sufficient, and that the patron who brings good milk will not suffer under this. The greater the variation in the fat content the oftener should the milk be tested.

DAIRY FARMING.

P. Collier[2] reports the results of comparisons of Holstein, Ayrshire, Jersey, American Holderness, Guernsey, and Devon breeds of cows during two periods of lactation; and L. L. Van Slyke[3] compares these same breeds for butter and cheese production. In the Columbian dairy test[4] Jersey, Guernsey, and Shorthorn breeds competed. The Jerseys came off victorious as economic producers of both butter and cheese, with the Shorthorns second best.

A record of a Norwegian herd for ten years, presented by H. O. Jölberg,[5] shows that in different years the average yield of milk per pound of live weight averaged, for the herd, between 4.39 and 6.6 pounds. The amount increased during the first eight years. The individual record for 1893 for a herd of 18 cows shows that the milk yield varied from 4,206 to 8,197 pounds during the year, and the yield per pound of live weight ranged from 4.4 to 7.3 pounds. There appeared to be no general relation between weight or age and yield.

From observations made by Backhaus[6] on a herd of 51 Dutch cows for one year, it appears that the average length of lactation was 329½ days, the average yield of milk 3,759 kilograms, and the average yield of fat 122.8 kilograms. The production of milk and fat in proportion to the live weight was relatively larger in the case of the lighter animals. The cows which gave milk the longest as a rule gave considerably the most milk and fat. The cows were in all periods of lactation from the second to the seventh; those in the third gave the largest yields.

L. Hansen[7] observed, from the record of tests of the individual cows of a herd in Denmark, that the largest annual yields per cow were 8,877 pounds of milk and 387.4 pounds of butter. To make 1 pound of butter required 21.1 pounds of the richest milk and 32.1 pounds of the poorest milk. The same author[8] gives the cost of food per pound of

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[1] Milch Ztg., 21 (1892), pp. 399–404, 417–419.

[2] N. Y. State Sta. Report for 1891, p. 28, and Report for 1892, p. 39; abs. in E. S. R., vol. IV, p. 255.

[3] Ibid., p. 370; abs. in E. S. R., vol. IV, p. 274.

[4] Breeder's Gaz., 1893, pp. 325, 362, 379, and Hoard's Dairyman, 1893, pp. 638, 662.

[5] Norsk Landmandsblad, 17 (1894), pp. 82, 83.

[6] Jour. Landw., 41, pp. 305–320; abs. in E. S. R., vol. V, p. 719.

[7] Ugeskr. Landmänd, 39 (1894), pp. 29, 30; abs. in E. S. R., vol. V, p. 813.

[8] Ibid., 39 (1894), Jan.; abs. in Milch Ztg., 23 (1894), pp. 118, 119.

butter for each of the cows of a herd for one year. This ranged from 15 to 43½ cents with the different cows, and averaged for all 23⅓ cents.

H. H. Wing[1] considers the cost of milk production from the individual record of 22 cows for one year. He concludes that the cost of food need not exceed 65 cents per 100 pounds of milk or 16 cents per pound of fat; that larger animals consume less dry matter in proportion to their weight than smaller animals; and that "for the production of milk and fat there is no food so cheap as good pasture grass."

A. La Cour[2] considers the importance of fat determination for the improvement of milch cows; and W. W. Cooke[3] states that the milk of the fourth month after calving is an excellent guide to the general quality of the milk of a cow. Adding one eighth per cent to its composition at this time gives a close approximation to the average quality for the whole period. The results were practically the same whether cows were tested once or twice a month.

C. A. Goessmann[4] found the nutritive effect of gluten meal, as shown by the yield of milk, to be slightly higher than that of an equal quantity of old-process linseed meal. H. H. Dean[5] found that wheat at $20 a ton was an economical food for milch cows, calves, and young pigs. J. B. Lindsey[6] found that a mixture of corn and soja-bean silage was fully equal to hay in keeping up the yield and the quality of milk, and diminished the cost of milk production. Hay of peas and oats was nearly or quite equal to good rowen, but roots were too expensive. The same author[7] has tested the feeding of green vetch and oats and green corn fodder as soiling crops; and H. H. Dean[8] has determined the area of land in soiling crops required to soil a cow.

F. W. Woll[9] reports the rations fed to dairy cows by 15 farmers in Wisconsin, and in a later bulletin[10] reports 100 typical rations fed by farmers in different parts of this country. Combining these rations with some others, making 128 in all, he finds that the average for all of these contains 24.51 pounds of dry matter, 2.15 pounds of digestible protein, 13.27 pounds of digestible carbohydrates, and 0.74 pound of digestible fat, with a nutritive ratio of 1:6.9. This he denotes as the American standard ration for dairy cows.

C. D. Woods and C. S. Phelps[11] have compared the rations fed to cows by 16 representative farmers in Connecticut. The digestible nutrients

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[1] N. Y. Cornell Sta. Bul. No. 52; abs. in E. S. R., vol. IV, p. 938.

[2] Ugeskr. Landmänd, 39 (1894), pp. 129–133.

[3] Agr. Science, 7 (1893), pp. 299–303.

[4] Mass. State Sta. Report for 1891, p. 15; abs. in E. S. R., vol. IV, p. 64.

[5] Ontario Agr. College and Exptl. Farm Report for 1893, p. 151.

[6] Mass. State Sta. Report for 1893, pp. 15–35.

[7] Ibid., pp. 35–45.

[8] Ontario Agr. College and Exptl. Farm Report for 1891, p. 186; abs. in E. S. R. vol. IV, p. 644.

[9] Wis. Sta. Bul. No. 33; abs. in E. S. R., vol. IV, p. 740.

[10] Ibid., Bul. 38; abs. in E. S. R., vol. V, p. 884.

[11] Conn. Storrs Sta. Report for 1893, pp. 69–115.

fed on an average per 1,000 pounds live weight were 2.48 pounds of protein, 0.94 pound of fat, and 14.09 pounds of carbohydrates, with a nutritive ratio of 1:6.5, and a fuel value of 34,800 calories. The digestible protein in the rations ranged from 1.35 to 3.16 pounds, and the fuel value from 28,750 to 42,600 calories. The following tentative ration is suggested: Organic matter, 25 pounds; digestible protein, 2.5 pounds; digestible fat, 0.5 to 0.8 pound; digestible carbohydrates, 12 to 13 pounds; nutritive ratio, 1:5.6; and fuel value, 31,000 calories.

C. A. Goessmann[1] has given the creamery record for the herd of the Massachusetts State Station for 1890, 1891, and 1892. The total cost of food per quart of cream amounted to 14.12 cents in 1890, 13.93 in 1891, and 13.35 in 1892. The amount of milk required to produce one quart of cream was 5.47 quarts in 1890, 5.78 in 1891, and 6.18 in 1892. The receipts per quart of milk from the local coöperative creamery amounted to 2.16 cents in 1890, 2.18 in 1891, and 1.99 in 1892.

Wittmach[2] gives a list of plants useful in dairying, classified as follows: Plants used for curdling milk, for preventing the curdling of milk, for coloring butter and cheese, for imparting a peculiar taste or color to milk, for imparting a desirable odor to cheese, for preventing butter from becoming rancid, and for replacing milk.

DAIRY TECHNOLOGY.

C. L. Penny[3] believes that milk sugar can be made from skim milk so as to give a profit, and details a method which he has worked out, suitable for creameries. He estimates that the cost need not exceed 13 cents per pound and that 3.25 pounds of commercial milk sugar can be made from 100 pounds of skim milk.

According to Hauser,[4] Reid's albumose milk is cows' milk to which egg albumen heated to 130° C. has been added. It more closely resembles human milk and is recommended for children. It coagulates the same as human milk and hence is more easily digested than cows' milk.

"Kunstrahm" (artificial cream) is the name applied by Dierking[5] to a mixture of equal parts of pure oil and a mucilaginous material. The latter prevents the fat from separating out when mixed with other liquids, as skim milk. It is said to remain in a finely divided condition as long as the fat does in normal milk. The preparation is used for mixing with skim milk to make it a more nutritious food for calves. Rape seed oil is usually used in the mixture, although other oil is used

[1] Mass. State Sta. Report for 1891, p. 73, and Report for 1892, p. 46; abs. in E. S. R., vol. IV, p. 66, and vol. V, p. 209.

[2] Molk. Ztg., 6 (1892), No. 48; abs. in Vierteljahr. Chem. Nahr. und Genussmtl., 7 (1892), p. 402.

[3] Del. Sta. Report for 1891, pp. 104–108; abs. in E. S. R., vol. V, p. 605.

[4] Berl. Molk. Ztg., 1893, No. 28; abs. in Vierteljahr. Chem. Nahr. und Genussmtl., 8 (1893), p. 213.

[5] Molk. Ztg., 7 (1893), p. 627.

when desired. The artificial cream is sold at $6 per 100 pounds. Very little is yet known as to its feeding value.

C. L. Penny[1] has tested the value of centrifugal cream for making ice cream. Ice cream makers object to centrifugal cream. Ice cream made from Cooley cream seemed to be rather better than that made from centrifugal cream, but the author believes that the treatment of the cream, age, acidity, etc., have more to do with the quality of the product than the manner of raising the cream.

Pott[2] describes "laktina," a substitute for human milk; and R. Koch[3] and D. H. Davis[4] describe the preparation of koumiss. Kafir milk is described in *Milch Zeitung;*[5] and the manufacture of milk soap from by-products of the dairy is described by E. Kayser.[6] The manufacture and composition of milk cake, a food material prepared from centrifugal skim milk by precipitating the casein, mixing it with some concentrated feed stuff, and pressing it into cakes for stock, has been mentioned.[7] C. Seckerling[8] gives directions for utilizing whey in making whey cake with wheat bran, whey vinegar, and brandy.

LITERATURE.

The following books on dairying, among others, have recently been issued:

Lehrbuch der Milchwirthschaft, W. Fleischmann; Bremen: M. Heinsius Nachfolger. 1893, pp. 355.

Industrie Laitière, P. de Vuyst; Brussels: Polleunis et Ceuterice, pp. 31.

Le Lait, Jules Rouvier; Paris: 1893.

Principes de Laitière, E. Duclaux; Paris: Armand, Colin et Cie., 1893, pp. 370.

Dairyman's Manual, Henry Stewart; New York, 1893, pp. 475.

Der praktische Milchwirth, E. Sachlich; Prenzlau: A. Mieck.

Milchwirtschaftliches Taschenbuch, for 1893 and 1894, B. Martiny; Bremen: M. Heinsius Nachfolger.

Unsere Milchwirtschaft, C. B. Charousek; Oesterr. Zentralvereines für Milchwirthschaft.

Allgemeine Geschichte der Milchwirthschaft, F. Anderegg; Zurich: O. Füssli, 1894, pp. 208.

Dairy Industry and Dairy Farming in Denmark, R. P. Ward; Crewe: 1893.

Report of the Dairy Industry of Denmark, C. C. Georgeson; Washington: U. S. Department of Agriculture, Bureau of Animal Industry, Bul. No. 5, pp. 133.

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[1] Del. Sta. Report for 1892, pp. 123, 124; abs. in E. S. R., vol, v, p. 796.

[2] Abs. in Molk. Ztg., 8 (1894), p. 95.

[3] Molk. Ztg., 6 (1892), pp. 466, 467, 478, 479.

[4] Pharm. Jour. and Trans., 23 (1892), p. 301.

[5] Milch Ztg., 21 (1892), p. 75.

[6] Deut. Molk. Ztg., 1893, No. 22; abs. in Vierteljahr. Chem. Nahr. und Genussmtl., 8 (1893), p. 104.

[7] Abs. in E. S. R., vol. III, p. 581; IV, p. 319.

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ABSTRACTS OF PUBLICATIONS OF THE AGRICULTURAL EXPERIMENT STATIONS IN THE UNITED STATES.

METEOROLOGY.

W. H. BEAL, *Editor.*

Meteorological summaries for North Carolina for January and February, 1894, H. B. BATTLE, C. F. VON HERRMANN, and R. NUNN (*North Carolina Sta. Weather Service Buls. Nos. 52, Jan. 31, 1894, pp. 3-17, charts 2; 53, Feb. 28, 1894, pp. 21-35, charts 2*).—Daily and monthly summaries of observations on temperature, pressure, precipitation, etc., by the State weather service, coöperating with the U. S. Weather Bureau.

Meteorology (*Arkansas Sta. Bul. No. 26, Jan., 1894, pp. 51, 52*).—Daily record of temperature and precipitation for the six months ending September, 1893.

SOILS—FERTILIZERS.

W. H. BEAL, *Editor.*

Soils and fertilizers, part II, P. SCHWEITZER (*Missouri Sta. Bul. No. 20, Jan., 1893, pp. 32, plates 18*).—A popular review of the work of Wagner on the function of potash, phosphoric acid, and nitrogen in fertilizers for various crops.

Fertilizer inspection and analysis in Maine, W. H. JORDAN, J. M. BARTLETT, and L. H. MERRILL (*Maine Sta. Bul. No. 7, 2d ser., Feb., 1894, pp. 12*).—Attention is called to the principal features of the law enacted by the State legislature at the session of 1893, and a schedule of trade values is given, with notes on valuation, a list of manufacturers complying with the law in 1894, and tabulated analyses of 58 fertilizers.

Fertilizer inspection and analysis in North Carolina, H. B. BATTLE (*North Carolina Sta. Special Buls. Nos. 19, Apr. 7, 1894, pp. 16; 20, Apr. 21, 1894, pp. 17*).—These bulletins give a digest of the State fertilizer laws, explanation of terms used in analysis of fertilizers, notes on valuation, transportation rates from the seaboard to inland points, and tabulated analyses of 355 fertilizers.

FIELD CROPS.

J. F. DUGGAR, *Editor.*

Corn vs. alfalfa, W. W. COOKE and F. L. WATROUS (*Colorado Sta. Bul. No. 26, Feb., 1894, pp. 4, 5*).—The following table shows the total yield of dry matter and the amount of digestible matter in a crop of corn and alfalfa, each occupying an acre of ground:

Yield per acre of corn and alfalfa.

	Total.		Digestible.	
	Corn.	Alfalfa.	Corn.	Alfalfa.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
Dry matter	5,539	10,304	3,605	5,611
Albuminoids	405	1,602	296	1,198
Nitrogen-free extract	3,263	4,782	2,186	3,114
Fiber	1,472	2,800	1,060	1,198
Fat	84	246	63	101
Ash	315	829	....	....

The variety of corn was Golden Beauty, and it was planted May 16 in hills 3 feet apart each way and irrigated once. The alfalfa was three years from seeding, was irrigated twice, and cut three times. The table indicates that a much greater feeding value can be secured from an acre of alfalfa than from an acre of corn.

Experiments with corn, J. S. NEWMAN (*South Carolina Sta. Bul. No. 14, Aug., 1893, pp. 6*).—A test of fertilizers, of detasseling, and of pulling fodder, all conducted in 1892 on land cleared in 1890. The plats used in the fertilizer experiment were not of uniform fertility. The fertilizers used were stable manure, compost, cotton-seed meal, nitrate of soda, superphosphate, kainit, and floats, alone and in various combinations. A drought in July injured those plants whose growth had been most hastened by fertilizers. A mixture of nitrate of soda, superphosphate, and kainit gave the largest yield, 19.4 bushels per acre. Floats alone and in combination gave better results than the same weight of superphosphate.

Alternate rows of corn were detasseled. The yield from detasseling averaged 16.2 bushels per acre; from not detasseling, 13 bushels.

Corn plants from which the leaves were stripped gave 18.9 bushels of corn per acre; when the leaves were not pulled the yield was 16.3 bushels. Brief notes on the preparation of recently cleared land are given.

Fertilizer experiments with corn, J. S. NEWMAN (*South Carolina Sta. Bul. No. 15, n. ser., Mar., 1894, pp. 6*).—An experiment in fertilizing corn grown on bottom land in 1893 occupied 31 plats. The fertilizers used were cotton-seed meal, superphosphate, kainit, floats, compost,

and two brands of "raw phosphate." The yield of corn and of fodder and the estimated profit and loss from the application of fertilizers are tabulated. No conclusions are drawn.

Experiments with oats, C. C. GEORGESON, F. C. BURTIS, and D. H. OTIS (*Kansas Sta. Bul No. 42, Dec., 1893, pp. 81–91*).

Synopsis.—A record of results of experiments with oats for the unfavorable seasons of 1892 and 1893. The experiments embraced (1) methods of preparing land, (2) time of sowing, (3) treating seed oats with hot water for smut, (4) heavy, medium, and light oats for seed, (5) methods of seeding, (6) amount of seed, and (7) varieties. The results in connection with those of former years favored spring plowing in 1893, sowing March 8 to 15, treating seed oats with hot water, using heavy seed, seeding with shoe drill with press wheels, using 4 bushels of seed per acre, and the Pedigree Red Rust Proof, Board of Trade, Belgian, and Brown Winter varieties.

Method of preparing land (pp. 82, 83).—Fall plowing, spring plowing, and disking the land were compared, as also cultivating the seed in *vs.* drilling. The results were not constant for different years.

Time of seeding (pp. 83–85).—This experiment occupied 45 plats, and oats were planted March 8, 15, 27, 29, April 5, 12, 19, 26, and May 3. The yield decreased as the date of planting became later.

Hot water treatment for smut (pp. 85, 86).—In 1892 and 1893 neither treated nor untreated plats were seriously affected by smut, the seed for these crops having been selected from the crop of 1891, the seed of which was treated. In 1891 the gain from treatment was 8 bushels, and the average gain for the three years was 3 bushels in favor of treating seed oats.

Light, medium, and heavy seed (pp. 86, 87).—The average results for four years give a yield of 32.05 bushels for light seed, 33.55 for medium seed, and 35.39 for heavy seed.

Methods of seeding (pp. 87, 88).—As the average of three years' trials broadcasting yielded 32.20 bushels per acre; seeding with the hoe drill, 34.62; seeding with a shoe drill with press wheels, 39.34; and seeding with a shoe drill without press wheels, 36.48.

Amount of seed (pp. 88, 89).—As the average of three years' trials 4 bushels gave a larger yield than smaller quantities.

Varieties (pp. 90, 91).—The yield of grain and straw for 1890, 1892, and 1893 and the average yield for these three years are tabulated for 34 varieties.

Sandwick, or hairy vetch (Vicia villosa), W. W. COOKE and F. L. WATROUS (*Colorado Sta. Bul. No. 26, Feb., 1894, pp. 3, 4*).—This plant was sown at the station June 10, 1893, in double rows 39 inches apart, using about 30 pounds of seed per acre. The plants were cultivated three times and irrigated once. During the last of December the plants were still green and growing, although the ground had been twice covered with snow and had remained frozen for two weeks in November. The yield of hay was at the rate of 3½ tons per acre, and this forage was relished by cattle and horses. Hairy vetch is espe-

cially recommended for fall, winter, and spring pasturage in the State. The following analysis of hairy vetch hay is given: Water, 10 per cent; ash, 8.31; fiber, 23.05; fat, 3.96; protein, 15.25, and nitrogen-free extract, 39.43.

Experiments with wheat, oats, barley, and potatoes, A. Boss (*Minnesota Sta. Bul. No. 31, Dec., 1893, pp. 201–214*).—Tests of varieties of wheat, oats, barley, and corn in 1893; methods of planting wheat, oats, barley, and potatoes; methods of preparing land for oats; heavy *vs.* light seed oats; and early *vs.* late seeding of oats. Blue Stem wheat yielded more than Fife. Of 7 varieties of oats the best yields were made by American White Banner and Early Gothland. Of 4 varieties of barley the best yields were made by Black and Success. Among 24 varieties of corn tested Lamb Yellow Dent is recommended for the State. Tests of the hoe drill, Campbell's seeder, and broadcast seeder were made with both wheat and oats, but the amounts of seed were not constant for the three machines, and hence the results are not comparable.

An experiment concerning the best depth for planting potatoes occupied 10 plats. The figures are inconclusive, though the author recommends deep planting both for quantity and quality.

As a preparation for oats, corn stubble was (1) disked twice, (2) plowed 4 inches deep, (3) plowed 7 inches deep, and (4) plowed 7 inches deep and rolled firm. All plats were harrowed and drilled. The following table gives the yield per acre of grain and straw, and the average quantity of water present in the soil and subsoil, based on determinations made June 20 and 30, July 22, and August 5, on an area of 1 acre.

Effect of different methods of preparing land on the yield of oats and water content of the soil.

Plat No.	Method of preparation.	Water in 3 inches of surface soil.	Water in 6 inches of sub-soil.	Yield of straw.	Yield of grain.
		Pounds.	*Pounds.*	*Pounds.*	*Bushels.*
1 and 5	Disked twice	38,565	92,828	1,431	37.53
2 and 6	Plowed 4 inches deep	44,331	97,336	1,738	38.70
3 and 7	Plowed 7 inches deep	43.573	95,844	2,051	39.52
4	Plowed 7 inches deep; rolled until very firm.	39,959	97,602	2,920	45.25

Oats and barley (100 grains in each hill of 1 square foot) were planted at depths increasing by $\frac{1}{4}$ inch from $\frac{1}{4}$ to 3 inches. With oats a greater number of grains germinated at a depth of $1\frac{3}{4}$ inches or less than at greater depths. With barley germination was better at a depth of 1 inch than at greater depths. Barley and oats were sown separately on large plats at depths of $\frac{1}{2}$, 1, $1\frac{1}{2}$, 2, $2\frac{1}{2}$, and 3 inches. With oats the largest yield of straw occurred with depths of $1\frac{1}{2}$ and 2 inches; of grain, with depths of $2\frac{1}{2}$ and 3 inches. With barley $1\frac{1}{2}$ inches gave the best results both in straw and grain.

Two bushels per acre of heavy oats weighing 37 pounds per bushel and 2 bushels of light oats weighing 21 pounds per bushel were sown. The heavy seed oats yielded 3,389 pounds of straw and 64.09 bushels of grain per acre; the light seed oats yielded 2,492 pounds of straw and 54.59 bushels of grain.

Oats sown April 18 made a larger yield than when the sowing was made April 29 or May 11.

Varieties of wheat, oats, barley, and sugar beets, W. W. COOKE and F. L. WATROUS (*Colorado Sta. Bul. No. 26, Feb., 1894, pp. 6, 7*).—The yields made by 27 varieties of wheat, 11 of oats, 2 of barley, and 7 of sugar beets are tabulated. Six varieties of wheat from India ranged in yield from 5 to 40 bushels per acre. Of 20 other varieties of spring wheat the largest yield (27.5 bushels per acre) was made by Defiance, followed by Chili and Australian Club. Clawson, the only winter wheat, yielded 33.2 bushels. The largest yield of oats (40 bushels per acre) was made by the New Zealand variety. The sugar beets were irrigated, and every variety gave a low sugar content.

Miscellaneous fodder crops, W. W. COOKE and F. L. WATROUS (*Colorado Sta. Bul. No. 26, Feb., 1894, pp. 7–9*).—German and Golden millet were grown. Soja beans failed to ripen seed and the crop was small, as were also the crops of Mexican beans and of lentils. Fifty-two varieties of sorghum were tested and only one kind, Haori, matured seed. Analyses of alfalfa hay from which most of the leaves had been shaken, and of the leaves with small portions of the stem, are given. An experiment in the field-curing of corn resulted in a loss of 34 per cent of its dry matter. There was no sign of heating or moldiness; the leaves remained green, but there was a decided smell of fermentation in the cured fodder.

Seeding, tillage, and irrigation at the Arkansas Valley Station, F. A. HUNTLEY (*Colorado Sta. Bul. No. 26, Feb., 1894, pp. 25–31*).—A general discussion of the soil and climate of the Arkansas Valley and of the culture of corn, wheat, oats, barley, and rye. The yields of several varieties of wheat are noted, Clawson, with 29 bushels, being the most productive of the winter varieties, and Sonora, with 29 bushels, of the spring varieties. A detailed statement of the cost of growing a field of 4½ acres of wheat is given; the profit amounted to $6.16 per acre.

HORTICULTURE.

F. C. TEST, *Editor.*

Garden notes for 1893, C. S. CRANDALL and M. J. HUFFINGTON (*Colorado Sta. Bul. No. 26, Feb., 1894, pp. 11–24*).—Notes on the growing of 15 varieties of tomatoes, 8 of beans, 3 of eggplants, 8 of peppers, 4 of sweet corn, 10 of cabbages, 5 of cauliflowers, and 21 of onions. The

following varieties are recommended: Tomatoes—Puritan, Ignotum, and Table Queen; beans—Golden Wax, Round Six Weeks, and Burpee Bush Lima; eggplants—Black Pekin and New York Improved; peppers—Ruby King; sweet corn—Early Minnesota and Cory Early; cabbages—Burpee All-Head Early, Premium Flat Dutch, and Louisville Extra Drumhead; cauliflowers—Early Snowball; and onions—Giant White Garganus and Extra Early Flat Red. Directions for the culture of each vegetable are included. Experiments with sweet corn were interfered with by the corn worm. As treatment for this pest, building fires in the fields in early spring to attract the moths is advised.

Varieties of apples in Arkansas reported as surest bearers, J. T. STINSON (*Arkansas Sta. Bul. No. 26, Jan., 1894, pp. 37–44*).—Reports from growers throughout the State as to the varieties which with them were the surest bearers. Of 45 varieties mentioned the following seemed to give the best satisfaction, in the order named: Ben Davis, Shockley, Winesap, Red June, Limbertwig, Early Harvest, and Horse.

Some apples adapted to all sections of Arkansas, J. T. STINSON (*Arkansas Sta. Bul. No. 26, Jan., 1894, pp. 44–47*).—A short list, with descriptions, of varieties found suitable for all sections of the State. The varieties were as follows: Summer apples—Carolina Red June, Early Harvest, Red Astrachan, Maiden Blush, Summer Queen, and Horse; fall apples—Buckingham, Taunton, Indiana Favorite, and Jonathan; winter apples—Winesap, Ben Davis, Hall, Nickajack, Limbertwig, Shockley, Smith Cider, White Winter Pearmain, and Romanite.

Arkansas seedling apples and nursery stock, J. T. STINSON (*Arkansas Sta. Bul. No. 26, Jan., 1894, pp. 48–50*).—A study of Arkansas seedling apples has been begun. Directions for purchasing nursery stock and a list of nurseries are given.

Blackberries and raspberries, variety tests and management, G. W. McCLUER (*Illinois Sta. Bul. No. 30, Mar., 1894, pp. 321–331*).—Descriptive notes on 16 varieties of blackberries and 14 of black and 19 of red raspberries. Of the blackberries, Snyder is ranked first and Minnewaska second. The latter, though not so good in quality as the Snyder, was productive, and not so liable to be injured by drought. Early King is recommended as an early variety. Kansas, a new variety, is put at the head of the black raspberries, with Gregg, or Nemaha, next, followed by Palmer. Of the red raspberries, Turner was found productive and hardy, with mild, pleasant fruit, but too soft for market. Cuthbert was healthy and bore larger, firmer fruit, but rather "harsh" in flavor. Philadelphia was very productive, but the fruit was smaller and liable to shatter.

Experiments for four years in the management of black raspberries showed that if the plants were thoroughly cultivated throughout the spring and summer the quality of the berries was improved and the

yield nearly doubled. The old wood should not be trimmed out until spring.

Small fruits in 1893, G. C. BUTZ (*Pennsylvania Sta. Bul. No. 25, Oct., 1893, pp. 12*).—Notes on the testing of 40 varieties of strawberries, 20 of raspberries, 10 of blackberries, 9 of currants, and 6 of gooseberries. The strawberries were grown in mats and hills, the mats producing the greater yield in most varieties, as shown in a table of 34 varieties, the Greenville leading with a quart of berries for every 8 inches of row. Tables are also given for raspberries, currants, and gooseberries, and 13 of the newer varieties of strawberries and 6 of raspberries are described.

DISEASES OF PLANTS.

WALTER H. EVANS, *Editor.*

Apple scab and bitter rot, J. T. STINSON (*Arkansas Sta. Bul. No. 26, Jan., 1894, pp. 23–44, fig. 1*).—Popular descriptive notes are given on apple scab (*Fusicladium dendriticum*) and bitter rot (*Glœosporium fructigenum*), with suggested means for their prevention. Formulas are given for Bordeaux mixture, ammoniacal copper carbonate solution, and copper sulphate solution.

To test the practicability of spraying for apple scab, two sets of experiments were conducted at the station on trees of the Winesap variety, this being the one most subject to the scab in that vicinity. In the first experiment 15 trees were selected, 9 sprayed and 6 left as a check. The fungicide used was Bordeaux mixture, and applications were made April 26, May 11, and June 5. About 5 gallons of the fungicide was used per tree. Including the fallen apples, there was an average of 1,351 apples on the sprayed trees and 1,375 on the check trees; but the number of apples picked from the sprayed trees was nearly double the number picked from the check. Only about 5 per cent of the apples on the sprayed trees showed scab, while on the unsprayed trees 91 per cent were affected. The sprayed trees yielded an average of $2\frac{3}{4}$ bushels of marketable apples per tree, while the unsprayed trees averaged about $1\frac{5}{8}$ bushels. The cost of spraying was 17 cents per tree, and the increased yield of marketable apples was made at a cost of less than 8 cents per bushel.

In the second experiment the dates of spraying were April 27, May 13, and June 3; the amounts of fungicide and cost of application were the same as in the first. All the fruit from the sprayed trees was sold to shippers, and was therefore classed as marketable, while but 42 per cent of the fruit of the check trees was of a quality suitable for market.

No experiments were conducted for the purpose of preventing bitter rot, but the results obtained in this connection from the work for apple scab are given. On the check trees considerable damage was done by bitter rot, while on 11 of the sprayed trees but 1 apple was affected.

Tests were made of the keeping qualities of sprayed and unsprayed fruit, showing that the application of the fungicide was very beneficial in increasing the keeping qualities of the apples when stored.

Reports are given from 35 counties on the prevalence of scab and bitter rot, showing that these diseases are quite common throughout the State, causing greater or less injury, in some cases amounting almost to a total destruction of the crop.

Spraying experiments, W. M. MUNSON (*Maine Sta. Bul. No. 8, 2d ser., Mar., 1894, pp. 4, figs. 2*).—A brief report on the tests of fungicides used for the prevention of apple scab. Modified eau celeste, Bordeaux mixture, Bordeaux mixture and Paris green, and Paris green alone were tested. The season was very dry, and the trees were much freer from scab than in previous years. Tabular information is given as to the results of spraying, showing that 61.7 per cent of the fruit of the check trees was affected by the scab. The trees sprayed four times with eau celeste yielded 27.2 per cent of scabby fruit; those sprayed four times with Bordeaux mixture, 20.1; and those sprayed four times with Bordeaux mixture and Paris green, 17.2. Much of the fruit classed as slightly scabbed would grade as No. 1 fruit. The modified eau celeste was less effectual than Bordeaux mixture in preventing scab, and also injured the foliage. It should be used with caution. The fruit was rendered somewhat rusty by its use, the epidermis apparently being injured by the ammonia.

The preparation of ammoniacal solution of copper carbonate, C. L. PENNY (*Delaware Sta. Bul. No. 22, Dec., 1893, pp. 16, figs. 2*).—The author has sought the most economical formula for making solutions of ammoniacal copper carbonate. In studying the questions involved in this problem the law of the solubility of copper carbonate in ammonia has been investigated. A large excess of copper carbonate was shaken in flasks with ammonia of various strengths and the clear solution filtered for analysis. The results obtained were somewhat conflicting, but seemed to establish an approximately efficient and economic strength of ammonia considerably less than that usually given in formulas for the fungicide. Ammonia diluted to about 3.2 per cent was found by the author to be the strength most economical for use.

The following practical suggestions are given for the preparation of the fungicide:

To 1 volume of 26° Beaumé ammonia (the strong ammonia of commerce) add from 7 to 8 volumes of water. Then add copper carbonate, best in successive quantities, until a large portion remains undissolved. The mixture should be vigorously agitated during the solution and finally allowed to subside, and the clear liquid poured off from the undissolved salt. A second portion should then be made by treating the residue of the former lot with more ammonia diluted as before, then with the addition of fresh copper carbonate, in every case with vigorous stirring or agitation. The method of making in successive lots will result in a richer solution of copper, at least unless an unwarranted length of time be taken. This solution may be made in any suitable wooden or stoneware vessel.

A still better way is to place in a large jar an inverted crock or other suitable shelf, and on this the copper carbonate, so that it shall be at the surface of the

ammonia when it is poured in. After adding the ammonia diluted as above, the whole should be allowed to stand, covered, some time, as over night, and then the undissolved copper salt may be in great part easily lifted out of the solution. Instead of the shelf a suitable receptacle may be used, as a fine wire sieve. The jar will need nothing but a loose cover as the loss of ammonia will be slight at that degree of dilution.

The clear solution thus obtained, containing from 3 to 4 per cent of ammonia gas, must be diluted as described above, in no case less than thirteenfold or fifteenfold; better, for the safety of the plant, twentyfold or more.

Those directions which recommend so much ammonia (whatever it may be) to be used as may be necessary to dissolve the copper salt and then to dilute to a given number of gallons, are not only not economical but absolutely dangerous, inasmuch as it is an uncertainty just how much ammonia may be used in the first instance and hence uncertain what strength it may have after dilution, when applied to the trees. It should be borne in mind always that if strong ammonia is used it must be diluted from first to last at least a hundredfold, and better considerably more.

A provisional bibliography of the more important works published on fungus and bacterial diseases of economic plants, W. C. STURGIS (*Connecticut State Sta. Bul. No. 118, Mar., 1894, pp. 35*).—The bulletin consists of a list of what are considered by the author the more important works published by this Department and the various experiment stations of the United States from 1886 to 1893, inclusive, on fungus and bacterial diseases of economic plants. In addition to the above-mentioned publications references are occasionally given to "Fungus diseases of the grape and other plants," and to *Garden and Forest*. The references are arranged chronologically under the subheadings of description and treatment for each disease, which is listed alphabetically by its common name under the various host plants.

ENTOMOLOGY.

F. C. TEST, *Editor*.

Black holes in wood, A. D. HOPKINS (*West Virginia Sta. Bul. No. 36, Feb., 1894, pp. 313–336, figs. 17, plate 1*).—Investigations as to the origin of the "black holes," stains, and "steamboats" in lumber. They were found to be due to a new species of Scolytid, the Columbian timber beetle (*Carthylus columbianus*), the adult of which is one sixth inch long and one sixteenth wide, with the body shining black above and below, with rust-colored legs and antennæ. It bores through the bark of oak, poplar, beech, etc., and directly into the sap wood for a short distance, then extending one or more branching galleries, in the sides of which are gnawed short chambers, a single egg being deposited in each. The larvæ feed upon the sap and pupate in the chambers. There is probably but one or two broods in a season.

The next season's growth of wood seals up the injury, which is thus finally embedded in the heart of the tree. A hole was found in an oak log dating back to 1755, and another in yellow poplar believed to have been excavated in the neighborhood of 1479. For a number of years the growths of wood over the holes are distorted, and in beeches the

wound will be apparent in the bark for a hundred years or more, resembling old shot wounds. The stains are probably due to the sap combining with the excrement of the larvæ to form a pigment, which spreads through the wood for a short distance in all directions.

On account of the widespread extent of the injuries and insufficient knowledge of the beetle, no remedies are suggested. A dipterous larva was found in some of the galleries, which perhaps infests the timber beetle, as no living Carthylids were found in such burrows.

Destructive locusts in Kentucky, H. GARMAN (*Kentucky Sta. Bul. No. 49, Mar., 1894, pp. 1–22, figs. 6*).—The life history and remedial treatment for locusts in general are described. Collecting the insects by means of "hopper dozers" and plowing under of the eggs are advised. Descriptions, life histories, distribution, and list of food plants are given for the bird grasshopper (*Schistocerca americana*), the red-legged grasshopper (*Pezotettix femur-rubrum*), the lesser migratory locust (*P. atlanis*), the differential locust (*P. differentialis*), and the yellow-striped locust (*P. bivattatus*).

The bud worm of tobacco, H. GARMAN (*Kentucky Sta. Bul. No. 49, Mar., 1894, pp. 23, 24*).—Notes are given on the occurrence of *Heliothis rhexis* on tobacco and remarks on the injuries inflicted and its frequent confusion with the corn worm. Several specimens were bred and studied. Spraying with Paris green is advised where the worms are abundant, and hand-picking where less common; and the destruction of weeds about tobacco fields is advocated.

FOODS—ANIMAL PRODUCTION.

E. W. ALLEN, *Editor.*

Proteids of the wheat kernel, T. B. OSBORNE and C. L. VOORHEES (*Connecticut State Sta. Report for 1893, part IV, pp. 175–185*).—This paper is supplementary to the brief report of investigations on this subject given in the Annual Report of the Station for 1892 (pp. 143–146) (E. S. R., vol. IV, p. 934). The full account of the investigation is given in *American Chemical Journal* (*15, pp. 392–471*). As mentioned in the former report, the authors separated from the wheat kernel five distinct proteids, viz, a gliadin, a glutenin, a globulin (edestin), an albumin (leucosin), and a proteose. A proteose-like body, apparently distinct, was also obtained, but in too small quantity for examination. Wheat gluten is composed of gliadin and glutenin. In Fife wheat there was found 4.33 per cent of gliadin and 3.96 per cent of glutenin, and in Fultz wheat 4.25 per cent of gliadin and 3.91 per cent of glutenin. Experiments described indicate that "both glutenin and gliadin are necessary for the formation of gluten, * * * and that these proteids combine with about twice their weight of water in forming gluten. The fact that the added gliadin entered so readily and completely into the formation of gluten indicates that it exists in the seed as such and undergoes no chemical change during extraction and drying. * * *

The gliadin alone is not sufficient to form gluten, for it yields a soft and fluid mass, which breaks up entirely on washing with water. The insoluble glutenin is probably essential by affording a nucleus to which the gliadin adheres and from which it is not mechanically carried away by the wash water."

A review of the work of other students of this question is given.

Proteids of the kidney bean; T. B. OSBORNE (*Connecticut State Sta. Report for 1893, part IV, pp. 186–210*).—The author identified and separated in a state of comparative purity two distinct proteids, phaseolin and phaselin. The first was the most abundant and had the properties of a globulin; the other was not so definite in character. Both were characterized by great solubility in dilute solutions of sodium chloride and by yielding precipitates with acids which were soluble in sodium chloride brines. Phaseolin probably constitutes about 20 per cent of the bean. Its properties are described as follows:

In cold or warm distilled water it is entirely insoluble.

In sodium chloride solution and in very dilute acids and alkalies it is very readily soluble to a clear solution.

Dissolved in 10 per cent sodium chloride solution, it is not precipitated by acetic, hydrochloric, nitric, or sulphuric acids, added in either minute or considerable quantities, although when dilute hydrochloric acid is added to the 1 per cent sodium chloride extract of the beans the phaseolin is precipitated.

Dissolved in large proportion in 10 per cent sodium chloride solution, the proteid is precipitated by adding much pure water.

Solutions of phaseolin in brine are completely precipitated by saturation with ammonium sulphate, but only slightly by saturation with magnesium sulphate or sodium chloride.

Potassium ferrocyanide and acetic acid together give a precipitate.

With copper sulphate and caustic potash the usual violet coloration is obtained, and with nitric acid the xanthoproteic reaction.

Dissolved in 10 per cent sodium chloride solution and heated very slowly in a double water bath, no turbidity occurs until the temperature is raised to 95°. This turbidity slowly increases as the temperature approaches 100°, and after some time a flocculent precipitate begins to develop, which even after heating for an hour is but slight.

Like other plant globulins, phaseolin separates from warm concentrated solutions on cooling, and from salt solutions on dialysis in the form of spheroids.

In composition phaseolin closely resembles animal myosin and the myosins found in the seed of maize and oats, but differs from these in other respects. The average of analyses of 24 different preparations of phaseolin is as follows:

Phaseolin.

	Per cent.
Carbon	52.58
Hydrogen	6.84
Nitrogen	16.47
Sulphur	0.56
Oxygen	23.55
	100.00

This is the proteid described by Ritthausen in 1884, to which he assigned very nearly the same composition as that above given.

The other proteid, phaselin, is much more soluble, remaining in solution after the

phaseolin has separated. It is slowly coagulated by heat at temperatures varying with the amount of salts present and the rapidity of heating. It is precipitated by acids, on prolonged dialysis yields insoluble or albuminate modifications, and has more nearly the properties of a globulin than of any other recognized class of proteids. It has an unusually low nitrogen and high oxygen content, as shown by the subjoined average of the analyses of 11 different preparations:

Phaselin.

	Per cent.
Carbon	51.60
Hydrogen	7.02
Nitrogen	14.65
Sulphur	0.49
Oxygen	26.24
	100.00

In addition to these two globulins, the extracts were found to contain an extremely small amount of proteose.

Proteids of cotton seed, T. B. OSBORNE and C. L. VOORHEES (*Connecticut State Sta. Report for 1893, part IV, pp. 211-217*).—The cotton seed used was freed of the husk and the fat removed with benzine. It was then extracted with water with 10 and 20 per cent sodium chloride solution and with 0.2 per cent potash water. The results were not altogether satisfactory to the authors, unusual difficulties being encountered in filtering the extracts and in separating the coloring matters. With brine a globulin was extracted agreeing in composition and in general properties with the vitellin obtained from the seeds of wheat, maize, hemp, castor bean, squash, and flax, to which the name edestin is given. The largest amount of this found in the oil-free meal was 15.83 per cent, and it contained 42.3 per cent of the total nitrogen in the meal.

The proteid matter dissolved by water consisted almost wholly of proteose, amounting to about 0.75 per cent of the oil-free meal. The potash extract contained so much gummy matter that it filtered difficultly, and no preparation was made. The nitrogen in the extract represented 44.3 per cent of the total amount in the meal. The residue from the extraction with potash water contained nitrogen equivalent to 11.4 per cent of the total amount in the meal.

Digestion experiments, F. E. EMERY and B. W. KILGORE (*North Carolina Sta. Bul. No. 97, Jan., 1894, pp. 87-132, fig. 1*).—Digestion experiments are described with cows, steers, and goats on soja-bean hay, cat-tail millet, Johnson-grass hay, sorghum fodder, sorghum bagasse,* peanut-vine hay, crimson-clover hay, corn meal, corn-and-cob meal, and the following rations: Sorghum bagasse and cotton-seed meal, crimson-clover hay and cotton-seed meal, cotton-seed meal and cotton-seed hulls in several proportions, corn silage and cotton-seed meal, crimson-clover hay and corn meal, and crimson-clover hay and corn-and-cob meal.

The composition of some of the materials fed is as follows:

* Residue of the stripped sorghum canes after grinding.

Composition of feeding stuffs fed in digestion experiments.

	Water.	Ash.	Protein.	Fat (ether extract).	Nitrogen-free extract.	Crude fiber.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Soja-bean hay	17.38	6.35	15.53	2.66	32.52	25.55
Cat-tail millet	11.04	8.10	11.56	2.28	40.20	26.82
Johnson-grass hay	12.31	5.15	5.77	1.67	44.80	30.30
Sorghum fodder (leaves alone)	12.43	4.56	9.60	4.55	44.93	23.93
Peanut-vine hay	10.44	6.80	10.31	3.57	42.92	25.96
Sorghum bagasse	11.25	2.88	3.44	1.44	50.47	30.52

The digestion experiments were carried out as usual, the trials each lasting from twelve to fourteen days or more, and the excreta being collected on the last five days. The digestion coefficients found in these trials are given in the following table:

Coefficients of digestibility.

	Ash.	Protein.	Albuminoids.	Fat (ether extract).	Nitrogen-free extract.	Crude fiber.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Soja-bean hay:						
Goat	....	70.07	52.95	18.75	71.47	62.14
Cow	56.71	75.75	66.10	71.86	52.02	54.80
Cat-tail millet, goat:						
First trial	69.35	64.58	45.58	44.66	60.00	68.36
Second trial	67.45	60.57	37.41	47.55	58.27	64.66
Johnson-grass hay, goat	56.10	44.71	39.58	39.48	54.37	57.83
Sorghum fodder (leaves):						
Goat	17.64	59.46	43.05	47.14	62.51	64.88
Cow	41.31	62.20	47.23	46.25	66.55	75.88
Sorghum bagasse, goat	13.35	13.65	2.59	46.42	64.84	63.75
Peanut-vine hay:						
Black goat	19.65	63.59	53.98	69.77	69.67	52.61
Gray goat	21.24	63.03	51.92	62.11	69.34	51.20
Crimson-clover hay:						
Cow	67.37	69.97	63.01	51.44	69.66	58.12
Goat	51.47	66.49	59.28	35.13	63.44	44.69
Corn meal, goat	....	66.89	73.27	80.47	94.22	....
Corn-and-cob meal, goat	....	65.21	71.33	84.59	85.61	47.67
Corn cobs, goat	....	57.95	46.92	100.00	49.12	96.34
Cotton-seed meal digested when fed with—						
Sorghum bagasse, goat	3.01	85.48	85.69	92.01	55.06	....
Crimson-clover hay:						
Cow	19.77	88.12	86.18	92.39	43.84	46.83
Goat	37.98	96.12	85.41	91.53	71.02	100.00
Cow	36.50	82.87	82.48	87.91	56.58	9.64
Cow	31.77	84.19	84.15	86.85	74.60	29.41
Ration of cotton-seed hulls and meal, 3 to 1:						
Steer	28.87	60.98	60.50	86.96	55.31	49.63
Steer	33.01	62.33	61.82	84.20	51.76	43.55
2 to 1:						
Steer	30.27	61.55	61.09	83.68	53.55	43.12
Steer	22.08	63.18	62.68	77.22	44.23	52.53
Steer	31.59	66.16	65.70	87.30	54.70	46.54
Cotton-seed hulls digested when fed with—						
Cotton-seed meal, 3 to 1:						
Steer	25.79	....	....	83.04	53.60	49.79
Steer	34.89	....	....	75.74	48.88	43.39
2 to 1:						
Steer	28.40	....	....	72.79	50.77	42.93
Steer	5.77	....	....	50.64	37.12	52.98
Steer	31.77	....	....	82.16	51.88	46.56
Ration of corn meal and crimson-clover hay:						
Goat	62.11	70.55	....	72.41	83.84	50.93
Goat	41.81	62.33	....	68.21	81.26	47.17
Ration of corn-and-cob meal and crimson-clover hay:						
Goat	44.72	63.67	....	62.17	76.81	44.05
Goat	49.13	59.33	....	66.92	80.34	56.81

The soja beans for this experiment were grown after an early crop and were cut in September, when a portion was in bloom, with the most forward part of the crop showing nearly mature seed. * * *

Neither the cow nor the goat ate enough of this hay to maintain the live weight. The digestion by the two animals was quite uniform. Comparing the coefficients found for this hay with those for soja-bean silage [North Carolina Sta. Bulletin No. 87*d;* E. S. R. vol. IV, p. 737] there is a fair degree of correspondence. * * *

Peanut-vine hay consists of the top of the plant after the kernels are removed. * * * The peanut-vine hay subjected to digestion in this experiment was in good condition and contained a considerable lot of "puffs" and some peanuts containing good meats. It was raised in a sandy soil. * * * This hay was eaten very well, and one goat maintained his weight on it while the other fell off a little. The percentages digested are very uniform, and show this part of the peanut plant in a very favorable light. * * *

Sorghum bagasse is the residue of the stripped sorghum canes after grinding. The sample submitted to digestion was cut into short lengths with a silage cutter. It resembles cotton-seed hulls in composition; is materially more digestible than hulls, but not so readily eaten. When fed fresh, before it dries out, or is preserved in a silo, it is eaten with considerable relish. Our experience with it leads us to believe that it is a waste by-product that can be used to advantage by some. * * *

As far as carried, the digestibility of cotton-seed hulls reached a maximum when there was 3 pounds of hulls eaten to 1 pound of cotton-seed meal. * * *

The goat did not eat the corn meal alone very readily, and the amount consumed is quite small as is also the dung excreted. The dung contained considerable mucus, and nonalbuminoids to the amount of 4.64 per cent of the total dung. Albuminoids were determined by the Stutzer method; finding soluble protein not precipitable by copper hydrate was rather a surprise, since all the protein of the corn meal fed was in the form of albuminoids. * * *

In all the experiments with corn meal, corn-and-cob meal, and rations of these with crimson-clover hay, soluble protein was present in the dungs, and to an extent that we think could hardly be accounted for by the presence of mucus, bile, and other intestinal products. In all the other experiments reported in this bulletin, albuminoids were determined in the dungs, and found to agree with total protein, and much narrower ratio rations of cotton-seed meal and hulls, and crimson-clover hay were fed than those of corn meal and corn-and-cob meal and crimson-clover hay. It would seem, therefore, that the albuminoids of the corn meal and corn-and-cob meal have undergone change in the digestive tract. In consequence of this, albuminoids in all the experiments with corn meal and corn-and-cob meal have a real and an apparent digestibility [the apparent digestibility being greater than the real].

Practical rations for lambs, W. M. HAYS (*Minnesota Sta. Bul. No. 31, Dec., 1893, pp. 193–200*).

Synopsis.—A comparison on 90 sheep of cracked corn and barley, alone and with linseed meal, and of wheat screenings and its principal components, using lambs and wethers. Cracked corn gave better results than barley, and both feeds were improved by adding linseed meal. The largest profits were from the mixture of corn and linseed meal, and from wheat screenings. The lambs gave larger gains and profits than the wethers.

Eighty Shropshire grade lambs, averaging about 75 pounds in weight, and 10 wethers from Montana averaging 107 pounds in weight were used in the experiment. The lambs were divided into 8 lots of 10 each, and the wethers were fed in a lot by themselves to compare their gains with those of the lambs. The further object was to compare a

number of common grain feeds on the lambs, and to compare wheat screenings with its three most prominent constituents, namely, small wheat, wild buckwheat and pigeon-grass seed, with a view to estimating the value of screenings from a mechanical analysis. The food of each lot was as follows:

Lot 1, lambs, cracked corn and hay.
Lot 2, lambs, 9 parts cracked corn and 1 part linseed meal, and hay.
Lot 3, lambs, barley and hay.
Lot 4, lambs, 9 parts barley and 1 part linseed meal, and hay.
Lot 5, lambs, small wheat and hay.
Lot 6, lambs, wild buckwheat and hay.
Lot 7, lambs, pigeon-grass seed and hay.
Lot 8, lambs, wheat screenings and hay.
Lot 9, wethers, wheat screenings and hay.

The experiment lasted twelve weeks, commencing in December. The hay was fed *ad libitum*, but the daily ration of grain is not stated. The sheep were kept in pens under the station barn, the inclosure being open on one side. In calculating the profit from the feeding, hay was reckoned at \$7.13 per ton, corn at \$13, barley at \$14.52, wheat screenings and its components at \$10.56, and linseed meal at \$27.87, which were the average prices prevailing at the time, and no allowance was made for the value of the manure. The lambs were bought at 5 cents per pound and the wethers at 4.2 cents; they were sold in the spring at 6 and 5 cents per pound, respectively. The results for each lot were as follows:

Summary of results of feeding lambs and wethers.

No. of pen.	Kind of sheep.	Kind of grain fed.	Gain in weight.	Hay eaten.	Grain eaten.	Total cost of food.	Total increase in value.	Total profit.	Received from grain, eliminating hay at cost.	Proportionate prices received per ton for grain.
			Lbs.	*Lbs.*	*Lbs.*					
1	Lambs..	Cracked corn..	211	849	1,103	\$10.06	\$19.76	\$9.70	\$16.89	\$25.60
2	...do	Cracked corn and linseed meal.	289	634	1,427	12.48	24.56	12.08	22.42	28.52
3	...do	Barley..........	199	630	1,268	11.51	19.27	7.76	17.14	24.77
4	...do	Barley and linseed meal.	274	603	1,591	14.78	24.01	9.22	21.97	26.01
5	...do	Small wheat...	202	742	1,505	10.46	19.49	9.03	16.98	19.66
6	...do	Wild buckwheat.	237	591	1,934	12.21	21.76	9.55	19.76	18.81
7	...do	Pigeon-grass seed.	226	427	1,975	11.86	20.97	9.11	19.53	18.65
8	...do	Screenings of wheat.	244	609	1,776	11.43	22.00	10.57	19.94	20.32
9	Wethers	....do	172	542	2,110	12.96	17.14	4.18	15.31	14.04

It will be seen that the largest gain was made by the lot on cracked corn and linseed meal, and the next largest by the lot on barley and linseed meal. The addition of linseed meal to cracked corn or barley increased the gain in weight and the profit.

Rating the profits proportionately on grain and hay according to the cost of the amounts of each fed, the corn fed with hay produced 80 cents per ton more than the barley when fed to lambs.

When both were thus fed with an addition of one tenth linseed meal, about $2 more per ton was received for the corn than for the barley.

With the corn worth $13 per ton, or 36½ cents per bushel, the barley was worth, as shown by the lambs, $12.30 per ton, or 29½ cents per bushel; the screenings (90 per cent small wheat grains and edible weed seeds) about $10.35 per ton; the small wheat (90 per cent small shrunken wheat), $10 per ton; the wild buckwheat (90 per cent wild buckwheat), $9.56 per ton; and the pigeon-grass seed (90 per cent pigeon-grass seed), $9.40 per ton.

The feeding value [of wheat screenings] for sheep may be calculated with fair accuracy by first determining the total percentage of grains of wheat, oats, barley, and edible weed seeds, and floury particles of such grains and seeds, and giving this three fourths the value of corn or barley at ruling prices.

It paid well to feed one tenth oil meal in the grain ration, both when feeding corn and when feeding barley.

The pens of lambs which made the most clear profits in increased value above cost of grain and hay at prices named in table, were those fed cracked corn with one tenth oil meal and those given a fairly good sample of wheat screenings. The lambs fed barley gave the least profit per head.

While grade Shropshire lambs purchased at 5 cents per pound in the fall, and fed hay and screenings, and sold at 6 cents in the spring—made a profit of $1.05 each, Western two-year-old wethers (evidently grade Merinos) bought at $4.20 per hundred weight, and sold in the spring at 5 cents per pound, gave a profit of only 40 cents each. The lambs got a half more of value per ton out of the food they consumed than the wethers.

MISCELLANEOUS.

Miscellaneous agricultural topics contained in the press service bulletins (*North Carolina Sta. Bul. No. 96, Jan. 20, 1894, pp. 55–84, figs. 21*).—This is a reprint of the seven press bulletins issued from June to December, 1893, consisting of popular notes on the following subjects: Meteorology, fertilizers for onions and for clover, best varieties of early corn and turnips, best method of keeping Irish potatoes, evaporated sweet potatoes, keeping sweet potatoes through winter, culture of asparagus, commercial bulb culture in North Carolina, warehouse and flour-mill pests, the horn fly, gapes in fowls, practical stock feeding, feeding pigs, and hand cream separators.

ABSTRACTS OF PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE.

Report of the International Meteorological Congress at Chicago, August 21–24, 1893, part I (*Weather Bureau Bul. No. 11, pp. 206, plates 10*).—Minutes of the proceedings and papers of the sections of Weather service and methods, Rivers and floods, and Marine meteorology are given. The following is a list of the papers included in this part: Meteorological stations and the publication of results of observation, J. Hann, director Austrian Meteorological Service, Vienna; The publication of weather maps and bulletins, R. H. Scott, secretary Royal Meteorological Council, London, England; Functions of State weather services, H. H. C. Dunwoody, assistant chief U. S. Weather Bureau, Washington, D. C.; The predictions of droughts in India, W. L. Dallas, assistant meteorological reporter to the Government of India, Calcutta, India; Can we, by automatic records, at three selected stations determine the energy of a flash of lightning? A. McAdie, U. S. Weather Bureau, Washington, D. C.; The utilization of cloud observations in local and general weather predictions, A. McAdie; An international cipher code for correspondence respecting the aurora and related conditions, M. A. Veeder, Lyons, N. Y.; The best method of testing weather predictions, W. Köppen, Marine Observatory, Hamburg, Germany; The present conditions of the weather service—propositions for its improvement, with appendixes on the Canadian, Danish, Norwegian, Russian, Austrian, Hungarian, Netherland, British, Berlin, Swiss, and United States services, W. J. van Bebber, Marine Observatory, Hamburg, Germany; Floods of the Mississippi River, with reference to the inundation of the alluvial valley, W. Starling, chief engineer, Mississippi Levee Commission, Greenville, Miss.; Flood planes of the Mississippi River, J. A. Ockerson, U. S. engineer, Mississippi River Commission, St. Louis, Mo.; River-stage predictions in the United States, T. Russell, office of U. S. engineers, Sault Ste. Marie, Mich.; Methods in use in France in forecasting floods, M. Babinet, assistant secretary of the Commission for Forecasting Floods, Paris, France; The four great rivers of Siberia, F. O. Sperk, Smolenzk, Russia; Regimen of the Rhine region, high-water phenomena and their prediction, M. von Tein, Central Bureau of Meteorology and Hydrography of Baden, Carlsruhe, Germany; The Nile, W. Willcocks, direc-

tor-general of the reservoirs of Egypt, Cairo; The best means of finding rules for predicting floods in water courses, M. Babinet, Paris; The forecasting of ocean storms and the best method of making such forecasts available to commerce, W. Allingham, London, England; The creation of meteorological observatories on islands connected by cable with a continent, Albert, prince of Monaco; The marine nephoscope and its usefulness to the navigator, C. Abbe, U. S. Weather Bureau, Washington, D. C.; The barometer at sea, T. S. O'Leary, U. S. Hydrographic Office, Washington, D. C.; The secular change in the direction of the magnetic needle —its cause and period, G. W. Littlehales, U. S. Hydrographic Office, Washington, D. C.; Relations between the barometric pressure and direction and strength of ocean currents, W. H. Beehler, chief of division of meteorology, U. S. Hydrographic Office, Washington, D. C.; The periodic and nonperiodic fluctuations in the latitude of storm tracks, M. A. Veeder, Lyons, N. Y.; North Atlantic currents and surface temperatures, A. Hautreux, French Navy; and Storms in the South Atlantic, A. P. Pinheiro, chief of the Meteorological Service of the Brazilian Navy, Rio de Janeiro, Brazil.

Leguminous plants for green manuring and for feeding, E. W. ALLEN (*Office of Experiment Stations, Farmers' Bul. No. 16, pp. 24*).—This bulletin discusses the relative value of leguminous crops for green manuring as compared with feeding, and urges that the more rational practice is to feed the crops to stock, save the manure, and apply it to the soil. In support of this the results of trials in this country and abroad are cited. The subject of green manuring in general, the ability of leguminous plants to acquire nitrogen from the atmosphere, and the composition of leguminous crops with reference to both food and fertilizing ingredients are discussed, and descriptions are given of various leguminous plants which have given promise in different parts of the country. The following extracts are from the author's summary:

Green manuring with clovers, peas, beans, lupines, etc. (leguminous crops), actually enriches the soil in nitrogen drawn from the air. These plants can grow with very little soil nitrogen. They store up the nitrogen of the air as they grow, and when plowed under give it up to the soil and to future crops. It is the cheapest means of manuring the soil with nitrogen.

But animals, as well as plants, require nitrogen for food. By feeding the crops of clover, cowpea, etc., only about one fourth of the fertilizing materials of the crop is lost if the manure is properly cared for. As the nitrogen of the air is the cheapest source of nitrogen for plants, so it is the cheapest source of protein (nitrogen) for animals. * * *

The practice of green manuring on medium and better classes of soils is irrational and wasteful. The farmer should mend his system so that the barnyard manure will be as well cared for as any other farm product. Loss from surface washing, leaching, fermentation, and decay should be guarded against. Then the feeding of richer food will mean richer manure and better and cheaper crops. * * *

For renovating worn or barren soils, and for maintaining the fertility where the barnyard manure is not properly cared for, green manuring with such leguminous crops as cowpea, clovers, and lupines is recommended. A dressing of potash and phosphates will usually be sufficient for the green manuring crop. * * *

Hay from leguminous crops is about twice as rich in protein as hay from grasses. In the one case this protein (nitrogen) is obtained very largely from the atmosphere; in the other it is all drawn from the fertility of the soil. Leguminous crops yield larger crops of hay to the acre than grasses. Hence the production of food materials on an acre, especially protein, is several times larger with leguminous crops.

An important enemy to fruit trees—the San José scale, L. O. HOWARD (*Division of Entomology, circular No. 3, 2d ser., Apr., 1894, pp. 1–10, figs. 5*).—An advance notice of this bulletin was given in a previous issue (E. S. R., vol. v, p. 935). The treatment is especially dwelt upon. Where trees have become badly infested, the best course is to at once cut them down and burn them. Before they have begun to secrete scales the young lice may be destroyed by spraying with kerosene-soap emulsion. During the winter washes may be applied to the older scales. For this purpose the following resin wash is often used:

Resin	30 pounds.
Caustic soda (70 per cent strength)	9 pounds.
Fish oil	4½ pints.
Water to make	100 gallons.

Another wash much used in California is compounded as follows:

Unslaked lime	10 pounds.
Sulphur	5 pounds.
Stock salt	4 pounds.
Water to make	15 gallons.

The sulphur, half the lime, and 8¼ gallons of water are boiled for an hour, the remainder of the lime being slaked with the salt meantime. After mixing the whole together it is strained, and constantly stirred while being sprayed.

Or the trees may be fumigated with hydrocyanic acid gas under canvas tents, a thorough method, though rather expensive.

Report of the statistician (*Division of Statistics, Report No. 114, n. ser., Apr., 1894, pp. 159–218*).—This is devoted to reports on the condition of winter grain; wheat production in census years since 1869; the conditions and losses of farm animals; increase and decrease in the number and value of farms from 1880 to 1890; the agricultural development of Bosnia and Herzegovina, translated from Journal de l'Agriculture; the health of the people; the cotton crop of India for the years 1893–'94; reports of U. S. consular officers; and transportation rates

ABSTRACTS OF REPORTS OF FOREIGN INVESTIGATIONS.

The morphology and physiology of grafts, L. DANIEL (*Rev. Gen. Bot., 6 (1894), No. 61, pp. 5–21; No. 62, pp. 60–75, plates 2*).—The author gives a historical summary to show that grafting of herbaceous plants was known and employed from the time of Aristotle and Theophrastus. Aristotle is quoted as having grafted a cultivated artemisia upon a wild one, and other herbaceous graftings are mentioned to disprove the claim that herbaceous grafting is of comparatively recent origin. Among the list of forty-six successful grafts which the author succeeded in growing till fruit was produced are the following: Kidney beans on kidney beans; peas on beans; cabbage on cabbage, on kohlrabi, on turnip, on *Sysimbrium alliaria*, on *Brassica chieranthus*, on *Barbarea intermedia*, on stock, and various combinations of the above and other crucifers; fennel on wild carrot; carrot on parsnip, and *vice versa;* celery on parsnip; winter lettuce on wild prickly lettuce; spring lettuce on salsify; salsify on *Scorzonera; Barkhausia* on dandelion; toad flax on snapdragon; *Dianthus* on *Lychinis dioica;* almond on cherry; peach on cherry; prune on cherry; and many others.

The author in his study classifies the various grafts as annuals, biennials, and perennials. He found that grafts will unite between genera of the same or different subtribes in an order. Hollow-stemmed annuals will unite so long as the pith remains functional. In the case of trees the union is readily made, and the swelling about the graft is reduced to the minimum. Root grafting of herbaceous plants is the most successful, and the duration of grafted plants is more or less modified by the graft. Annuals grafted upon biennials or perennials continue to be annuals, and at the end of the season they cause the partial or total death of the stock. Biennial grafts remain biennial on either their own or on perennial stocks, and induce the death of the stock the same as in the case of annuals. An exception was given in the case of salsify becoming perennial when grafted upon *Scorzonera*. Perennial grafts on annuals or biennials perish with their stocks; however, they will continue to grow if regrafted on perennial stocks.

As a rule herbaceous grafts are less resistant to cold. The time of flowering is slightly retarded in all classes of annual plants, and likewise in biennials and perennials, at least for the first year. The graft and stock are influenced reciprocally. Sometimes the graft controls the growth of the stock, as in some crucifers and *Rosaceæ.*

Again, as in the case of beans and most herbaceous plants, the stock modifies the size of the graft; while in still other cases either stock or scion may be influenced by grafting. In grafting a cultivated plant upon a wild one the quality of the plant is generally depreciated, as was shown in the case of lettuce grafted on the wild lettuce or on salsify. If seed produced by a cultivated scion on a wild stock be sown, some of the plants will be found to revert to the wild type, and in a great measure will lose their value as food plants. This was shown in the case of turnips grafted on *Sisymbrium alliaria.* From this it is claimed that in grafting inferior stocks should not be selected for grafts, the seed of which are expected to be used in planting.

Under the physiology of grafts the author considers three heads, (1) transpiration in the graft, (2) production of starch under the influence of the increased transportation of the graft, and (3) the utilization by the graft of the reserve material of the stock. The representatives of different genera within a family are able to make use of the reserve material in the stock. The grafts develop as with their proper reserve material. The accumulated reserve material of the stock is rarely utilized by the graft of a plant of another family. In the case of plants of the same family the graft in general uses the reserve of the stock as though it were its own, and after fruiting one finds that the reserve of the stock is partly or entirely used up, depending upon whether it is a biennial or perennial. A notable exception is found in the case of the inulin of the *Cichoraceæ.* This substance is not absorbed by any scion except from plants whose roots contain inulin.

It has often been claimed that the swelling which is produced about a graft retards the passage of the elaborated material in the sap. The author considers this claim as hypothetical. In most tuberous rooted plants the graft alone can make only such reserve materials as are deposited above the swelling. If the scion does not ordinarily form reserve material the root stock does not become swollen, since it is incapable when once grafted of producing the materials which are elaborated by the stem proper. Two exceptions are noted to this rule, that of Milan cabbage on kohl-rabi and Mortagne cabbage on turnip.

A short time after herbaceous grafting the scions wilt under the influence of transpiration. The author has investigated the phenomena of transpiration in herbaceous grafts in the case of beans and cabbage. In the case of the bean grafts, one was placed under a bell jar, another kept in the open air, and each compared with a check plant not grafted. The graft in the open air was dead at the end of three days, due to the transpiration by the leaves. The plant under the bell jar began to show the first tissue of union in seven days. The union was well effected and the equilibrium reëstablished between stock and scion, but owing to insufficient nourishment the plant died in fifteen days.

In the case of thick-leaved plants, as cabbage, the plants for a long time were able to withstand the abnormal transpiration, and at the time the

experiment was abandoned on account of cold weather the union of the cabbage grafts seemed assured. As a rule, after grafting the circulation of the crude sap becomes very difficult, and the absorption of water is reduced with the diminished transpiration. The equilibrium between the amount of water taken up and given off, absorption and transpiration, if once destroyed in such thin-leaved plants as the bean, can not be restored, and the graft dies. In the case of thick-leaved plants this effect is not so marked, but is still often attended with fatal consequences. The use of the bell jar gives more favorable conditions. In herbaceous grafting it is necessary to consider that the scion produces in the plant a more or less morbid state, which causes the irregularities of transpiration. In practice it will generally suffice to operate in a saturated air, to provide a high temperature, and to reduce the evaporating surface to the minimum, but as each plant behaves differently under practically the same physiological conditions, it may often be necessary to know what are the most favorable conditions for union. Operating in a low temperature and in obscure light may favor the operation, but it is necessary to provide a certain amount of heat for cicatrization and of light for chlorophyll activity. In considering the circulation of the liquids in grafted plants two extremes must be taken into account, (1) where the water absorbed by the stock passes in small quantity into the scion, and (2) where the water penetrates the scion in very great abundance. In the first case, which is the more frequent, the graft makes less vigorous development, but flowers and fruits more abundantly. In the second case just the reverse is shown. The vessels are larger, the sprouts are more vigorous, and the flowers and fruit less abundant, as in the case of a tree too highly nourished. These phenomena at the beginning are physical, but later chemical changes take place which modify the cell contents, as is shown by the formation of starch under the influence of the graft. Examples are given of the increased starch and sugar formation in the case of cabbage on turnip, while in the case of turnip on cabbage the starch and sugar were unable to traverse the scar or swelling of the graft.—W. H. E.

Methods of applying fertilizers, T. SCHLÖSING, R. HEINRICH, L. GRANDEAU, and A. PRUNET (*Compt. Rend., 115 (1892), pp. 698, 768; 118 (1894), No. 12, pp. 653–656; L'Engrais, 9 (1894), No. 4, pp. 86, 87; No. 15, pp. 348–350*).—Foreign investigators are giving considerable attention to the question of distribution of fertilizers in the soil with a view to securing greater economy in their use.

The results of these investigations generally indicate a decided advantage from replacing the common method of uniformly mixing the fertilizing material with the whole mass of the surface soil by that of applying the materials altogether in rows parallel to those in which the plants are seeded.

Schlösing has investigated this subject for a number of years. His results appear to be conclusive, and are, moreover, confirmed by those

of Hansen, at Dalum, Denmark; Prunet, Petermann, and Tibulle-Collot,* and by practical experience in the north of France.

Schlösing experimented on a very poor artificial soil, in water-tight boxes, with a fertilizing mixture containing sulphate of potash (400 kg. per hectare), nitrate of soda (600 kg.), bone superphosphate (600 kg.), and sulphate of magnesia (250 kg.). In the first series the four salts were dissolved in water and intimately mixed with the soil. The soil of the second series was thoroughly mixed at the same time with an equal quantity of distilled water, the surface leveled and 8 trenches 15 cm. deep and 12 cm. apart laid off. In each of these one eighth of the fertilizer mixture was placed and covered, leaving the fertilizers at a depth of about 12 cm. Wheat, potatoes, beets, beans, and peas were grown in the boxes under conditions as nearly as possible like those which obtain in practice, and were in each case supplied during the season with an amount of water equal to 180 mm. In every case growth was more rapid in the second series and maturity later, but the plants were harvested the same day in each series. The excess of yield in the second series over that in the first for those crops which were successfully brought to maturity was as follows:

	Per cent.
Wheat (grain, chaff, and straw)	6.3
Dwarf beans (seed and straw)	29.3
Potatoes	26.0

The amounts of phosphoric acid assimilated by the plants in the second series were 25.3, 37.2, and 25.3 per cent in excess of the amounts assimilated by the plants in the first series.

Prunet experimented in the same line on potatoes grown on plats of hill and plain soil of known composition. The fertilizer consisting of nitrate of soda (150 kg. per hectare), sulphate of potash (150 kg.), and mineral superphosphate (300 kg.) was carefully mixed with the soil in one series, and in the other series applied in rows parallel to those in which the potatoes were planted. The yield of tubers, albuminoids, and starch was larger where the fertilizer was applied in rows than where it was mixed with the soil. This excess of yield amounted to 2,712 kg. of tubers, 63 kg. of albuminoids, and 758 kg. of starch on the upland soil; and 1,770 kg. of tubers, 39 kg. of albuminoids, and 658 kg. of starch on the plain soil.

As will be seen, the results confirm those of the earlier experiments of Schlösing. It is probable, as Schlösing has pointed out, that the nitrate of soda acts in the same manner in the two methods of application, but it is quite otherwise with the other fertilizing materials. Without doubt the sulphate of potash remains partly in solution, but is also partly in a fixed state, principally in combination with humus. The superphosphate is probably entirely fixed by the bases of the soil. On the plats in which the fertilizing materials were as completely dis-

*L'Engrais, 1894, Nos. 14 and 15.

seminated as possible the surfaces of contact of the potassic and phosphatic fertilizers with the constituents of the soil were very great, and as a result the fixation of these substances was very rapid. On those which received the fertilizers in rows the surface contact was greatly reduced and the fertilizers were therefore very slowly rendered insoluble. It was observed that the roots were especially strongly developed in the vicinity of fertilizers, which were on this account more completely utilized.

In the course of a very interesting study on the use of liquid manure Hansen experimented during three years (1890–'92) on the comparative action of this fertilizer spread uniformly over the whole surface or applied only between the rows. The crop grown was sugar beets. The manure was applied in different cases in June, July, and August. The average for the three years shows that, as compared with the application between the rows taken as 100, the result from applying over the whole surface was 86 when made in June, 65 when made in July, and 26 when made in August.

R. Heinrich, of the Rostock Station, Germany, has given considerable attention to a study of the best depths at which to apply fertilizers. He experimented with sulphate of ammonia, ground meat, ground bone, pulverized leather, dried blood, and ground horn, in glass vessels containing 4 liters of very light sand, poor in nitrogen. In one series the fertilizer was thoroughly mixed with the whole mass of sand, in the other only with the surface layer. The crop grown was oats.

With two exceptions (sulphate of ammonia and pulverized leather) the plants developed much more vigorously in the pots in which the fertilizers had been mixed with the sand. Except in the cases of sulphate of ammonia and of ground horn the yield of both straw and grain was noticeably larger when the fertilizer was mixed with the soil than when spread on the surface. In some cases, noticeably with pulverized leather and ground meat, the yield was fully one third larger when the fertilizer was mixed with the sand.

It appears that as a rule the results strongly favor the mixing of the fertilizer with the soil. The conditions in these experiments have not been entirely favorable to the elucidation of this question, since all of the organic nitrogenous fertilizers used have been of a kind which are readily transformed into nitrates and carried down by the drainage water into the lower layers of the soil. It should be borne in mind also that the pots were regularly watered and contained an amount of moisture greater and more uniform than that furnished in actual practice by rainfall; but in spite of these conditions, which tended to produce a uniform distribution in the soil of the fertilizers applied to the surface, the results show a very marked difference by the two methods of application, and it is reasonable to suppose that these conditions would be even more marked in actual field trials.

It is evident that these results are of sufficient practical importance to render a detailed study of the subject desirable.—W. H. B.

The influence of iron in the soil on the growth of barley, P. PETIT (*Compt. Rend., 117* (*1893*), *No. 26, pp. 1105–1107*).—For these experiments pots containing 1,800 grams of sand practically free from iron were used. Tho pots of series 1 each received 4 grams of the nuclein of barley containing 6.04 milligrams of iron; those of series 2, 5 grams of ferrous sulphate containing 0.98 gram of iron, and those of series 3, 4.4 grams of ferric sulphate, containing 0.999 gram of iron. The pots in series 4 served as checks. Each pot was fertilized with sulphate of lime, phosphate of potash, and nitrate of potash, receiving of the latter 0.93 gram. In each pot 20 grams of barley were planted. Ferric sulphate seemed to retard germination by several days. The growth of the plants varied greatly, as shown by the following table:

Effect of iron on height of barley plants.

		Mar. 21.	Apr. 15.
		Cm.	*Cm.*
Series 1	Nuclein	11	23
Series 2	Ferrous sulphate	10	20
Series 3	Ferric sulphate	3	5
Check	Nothing	7	20

The total weight of plants for each gram of seed was as follows: With nuclein, 48 grams; with ferrous sulphate, 40 grams; with ferric sulphate, 9 grams; without iron, 39 grams. From these figures it appears that ferrous sulphate in the proportion of 2.2 grams per kilogram of soil did not materially affect the growth, while the growth was considerably increased by nuclein and very much reduced by ferric sulphate. In the stems the percentage of iron was as follows: With nuclein 0.24; with ferrous sulphate, 0.51; with ferric sulphate, 0.48; without iron, 0.05; in the leaves, with nuclein, 0.25; with ferrous sulphate, 0.57; with ferric sulphate, 0.56; without iron, 0.05.

The author concludes that iron salts are readily absorbed by barley, and that they cause a more active assimilation of nitrogen. The ferric sulphate, though increasing the percentage of iron, acted as a poison, as indicated by the above table.—J. F. D.

Splitting cabbage stems, P. HAUGUEL (*Rev. Hort., 66* (*1894*), *No. 9, pp. 203–204, fig. 1*).—A description is given of a method for arresting the growth of cabbage heads nearly mature, and thereby preventing their cracking. This is performed by cutting the cabbage stem half or two thirds across with a sharp pruning knife and then extending the cut either up or down for a short distance. If the cabbage does not bend over by its own weight and thus widen the split a splinter of wood should be inserted to keep the cut surfaces apart. By this means the further growth of the heads is arrested and yet sufficient sap reaches them to keep them fresh until wanted for use.—F. C. T.

Experiments in manuring the grape, H. LAGATU (*Prog. Agr. et Vit., 11* (*1894*), *No. 10, pp. 257–260*).—These experiments were conducted

on an estate near St. Thibéry (France), the soil of which was of sedimentary origin and very homogeneous. The soil was very poor in lime and had been highly manured. Ten plats were used, each consisting of 144 vines, only half of which, however, were used in determining the yield. The object was to ascertain (1) the effect of adding lime to a soil poor in this element, (2) the relative values of organic and mineral nitrogen, and (3) the relative values of sulphate, carbonate, and chloride of potash. On 4 of the plats each vine received a mixture consisting of 200 grams of horn shavings, 100 grams of sulphate of potash, and 150 grams of superphosphate. To this formula was added on different plats 2 kg. of phosphatic slag, 2 kg. of mineral phosphate, 1 kg. of lime, and 1 kg. of gypsum for each vine. In no case did the addition of these calcareous fertilizers result in any considerable increase in the yield of grapes, and lime caused a notable decrease in the yield. The nitrogenous fertilizers compared were horn shavings, nitrate of soda, and sulphate of ammonia, each used in combination with potash, phosphoric acid, and gypsum. Sulphate of potash and carbonate of potash proved far superior to chloride of potash, the difference in the yield of grapes between the chloride and the other two forms being about 2,700 kg. per hectare in favor of the sulphate and carbonate of potash. It was noticed that at the time of harvesting the vines manured with carbonate of potash showed the most luxurious vegetation, the leaves being of a deeper green than those of any of the other lots. Vines manured with mineral nitrogen and with sulphate of potash showed a satisfactory growth and color of leaves. The vines manured with the standard formula of horn shavings, sulphate of potash, and superphosphate, supplemented by some form of lime, showed a less satisfactory condition of the leaves. On the unmanured vines and on those which had received chloride of potash in combination with other fertilizers the leaves were not nearly so green as on the other plats.—J. F. D.

The use of the internal characters of grape seeds in the determination of species and the distinction of hybrids, G. CHAUVEAUD (*Compt. Rend.*, *118* (*1894*), *No. 9*, *pp. 485–487*).—Study of the internal parts of grape seeds showed several characters which were useful additions to the external features usually alone employed for the separation of species. It required a special technique, but the labor amply repaid by insuring a certainty of determination before not possible. The points used in differentiation were the integument, the kernel, and the embryo.

The integument of grape seeds was found to be essentially a very hard coating, differing with various species in shape (in transverse and longitudinal sections), in thickness, in the manner of partitioning, and in the form of the cavity of the cellule. The contour of the kernel differed from the external form of the seed more or less, according to the species considered, and the form of the radicle end presented the most typical variations. The embryo gave accurate points not only by its form, but also by the proportions of the axis and cotyledons.

In order to make use of these characters in the determination of species it was necessary to examine many seeds from the same plant in order to eliminate any errors from individual exaggerations. To show the application, the example of *Vitis riparia* and *V. rupestris* is given. From the external features of the seeds it was difficult or impossible to distinguish the species, but with the internal characters the case was quite different, as shown by the following table:

Grape seeds distinguished by internal characters.

Diagnostic points.	*Vitis riparia.*	*Vitis rupestris.*
Thickness of integument	At most 200μ	Always exceeding 300μ.
Radicle end of kernel	Beak thick, short, rounded	Beak slender, long, very sharp.
Cotyledons	Abruptly enlarged at base, diameter much exceeding that of axis.	Gradually mingled with axis, diameter only slightly larger.
Axis	Much shorter than cotyledons	Much longer than cotyledons.

Any one of these characters gave a diagnostic difference, as, for instance, the first. All that was necessary to be done was to file the seeds after fixing them in a vise or forceps, when the difference in thickness of the coating, which was in general in the relation of one to two, could be readily perceived by the naked eye. With a lens the difference was even more striking. But the internal characters seemed to possess a much higher importance in the seeds of hybrids, which it was necessary to divide into two sorts—(1) seeds from a hybrid plant and (2) seeds produced directly by artificial hybridization.

In the first case, No. 117 (Millardet), a hybrid from *Vitis rupestris* fertilized by *V. cordifolia* was taken as an example. Externally the seeds resembled those of *V. cordifolia*, differing by a slight lengthening of the chalaza and raphe. The thickness of integument showed the influence of *V. rupestris*, as did also the kernel, in having a long sharp beak, whereas the radicle end in *V. cordifolia* terminated abruptly in a right or obtuse angle without a beak. The embryo showed a combination of characters, the cotyledons being like *cordifolia*, and the axis like *rupestris*.

In seeds from artificial hybrids the external characters were borrowed from the female plant, but the internal parts indicated the hybridization, the embryo making the fact certain, though the modifications were varied. For example, a variety of *Vitis vinifera*, "Servant," fertilized by *V. berlandieri*, produced some seeds with elongated embryos and with the cotyledons rectangular, as in French grapes, while in others the cotyledons were shortened to a cordate form, as in *V. berlandieri*. A great number of embryos showed a mixture of male and female characters in varied proportions, extreme and intermediate.

The investigations convinced the writer that it is possible, by careful study of the seeds, to determine the species and varieties from which they have come.—F. C. T.

TITLES OF ARTICLES IN RECENT FOREIGN PUBLICATIONS.

CHEMISTRY.

Some frequently neglected errors of analysis, H. D. RICHMOND.—*Analyst, 19 (1894), May, pp. 99–102.*

Direct titration of phosphoric acid (*Directes Titriren der Phosphorsäure*), E. GEISSLER.—*Pharm. Central Halle, 15 (1894), p. 145; abs. in Chem. Ztg., 18 (1894), No. 30, Repert., p. 93.*

Detection of adulteration of ground Thomas slag (*Zum Nachweis von Verfälschungen des Thomasmehles*), O. BÖTTCHER.—*Chem. Ztg., 18 (1894), No. 31, p. 565.*

On the interpretation of the results of water analysis (*Beitrag zur Beurtheilung unserer Trinkwasser*), N. NEDRÖDI.—*Chem. Ztg., 18 (1894), No. 32, pp. 585, 586.*

Concerning the absorbent power of butter for iodine (*Sulla proprietà dei burri di assorbire e trattenere lo jodio*), E. ZENONI.—*Staz. Sper. Agr. Ital., 26 (1894), No. 2, pp. 121–130.*

Methods of detecting adulterants in butter (*Procédés pour reconnaître la fraude des beurres par les matières grasses animales et végétales*), A. MÜNTZ.—*Bul. Min. Agr. France, 13 (1894), No. 1, pp. 49–67, figs. 4.*

Arata's method of detecting artificial coloring substances in wine (*Sul metodo di Arata per la ricerca delle materie coloranti artificiali aggiunte ai vini*), L. SOSTEGNI and F. CARPENTIERI.—*Staz. Sper. Agr. Ital., 26 (1894), No. 2, pp. 151–163.*

The presence of potassium chlorate in certain species of mushrooms (*Présence du chlorure de potassium dans quelques espèces de champignons*), E. BOURQUELOT.—*Bul. Soc. Mycol. France, 10 (1894), No. 2, pp. 88, 89.*

Trehalose in mushrooms (*Sur tréhalose des champignons*), E. BOURQUELOT.—*Bul. Soc. Chim. Paris, 11–12 (1894), No. 8, pp. 353–356.*

Mushroom poisoning (*Empoisonnement par les champignons*), E. BOURQUELOT.—*Bul. Soc. Mycol. France, 10 (1894), No. 2, pp. 90–93.*

BOTANY.

The natural history of the flower, J. C. WILLIS.—*Nat. Sci., 4 (1894), pp. 347–352.*

The diastatic ferment in plants (*Das diastatische Ferment der Pflanzen*), F. SCHLEICHERT.—*Abs. in Bot. Centbl., 58 (1894), No. 5, pp. 166, 167.*

Iron in its relation to plants (*Historisches zur Frage nach dem Eisen in seiner Beziehung zur Pflanze*), C. MÜLLER.—*Hedwigia, 33 (1894), No. 2, pp. 97–100.*

The localization of oils during the formation of seeds and fruits (*Localization des huiles grasses pendant la formation des graines et fruits*), E. MESNARD.—*Bul. Soc. Bot., France, 41 (1894), No. 2, pp. 114–121.*

Anatomical variation in the same species of plants in the region of the Mediterranean and the environs of Paris (*Modifications anatomiques des plantes de la meme espèce dans la région de la Méditerranée et dans la région des environs de Paris*).—*Compt. Rend., 118 (1894), No. 16, pp. 884–887.*

FERMENTATION—BACTERIOLOGY.

Concerning a yeast fermenting milk sugar and causing cheese to swell (*Ueber einen Milchzucker vergährenden und Käseblähungen hervorrufenden neuen Hefepilz*), N. BOCHICCHIO.—*Centbl. Bakt. und Par., 15 (1894), p. 546; abs. in Chem. Ztg., 18 (1894), No. 34, Repert., p. 106.*

Bacteriology in some of its relations to chemical science (*Die Bakteriologie in einigen ihrer Beziehungen zur chemischen Wissenschaft*), P. FRANKLAND.—*Centbl. Bakt. und Par., 15, pp. 101–112; abs. in Chem. Centbl., 1894, I, No. 17, p. 825.*

Bacteriology in its relation to mycology and physiology (*Ueber die Beziehungen der Bakteriologie zur allgemeinen Mykologie und Physiologie*), C. WEHMER.—*Centbl. Bakt. und Par., 15 (1894), No. 15, pp. 533–546.*

Behavior of cholera bacilli in hens' eggs (*Ueber das Verhalten von Cholerakulturen in Hühnereiern*), ZENTHÖFER.—*Ztschr. Hyg., 16, pp. 362–367; abs. in Chem. Centbl., 1894, I, No. 18, p. 872.*

A review of investigation on the bacteriological examination of water, II (*Bericht über Fortschritte und Leistungen auf dem Gebiete der bakteriologischen Wasseruntersuchung*), R. EMMERICH.—*Forschungsber. ü. Lebensmtl., 1, pp. 84–86; abs. in Chem. Centbl., 1894, I, No. 18, p. 870.*

WATER—SOILS.

Analyses of waters from wells in close proximity to churchyards, A. J. VOELCKER.—*Analyst, 19 (1894), May, pp. 107–109.*

The rôle of water in cultivated soil, (*Die Rolle des Wassers in Kulturboden*), H. PUCHNER.—*Ztschr. landw. Ver. Bayern, 84 (1894), Jan. and Feb., pp. 15–26; Mar., pp. 138–145.*

The valuation of agricultural soils on the basis of scientific data, II (*Zur Wertschätzung der Ackererden auf naturwissenschaftlich-statistischer Grundlage*), G. THOMS.—*Jour. Landw., 42, No. 1, pp. 1–31, fig. 1.*

FERTILIZERS.

The use of fertilizers (*De l'emploi des engrais*), J. DUMONT.—*Marquès et Cie., Toulouse, price 1.25 francs.*

On the loss of fertilizing material in night soil to which peat, superphosphate-gypsum, and kainit have been added (*Ueber die Verluste, welche die Fäkalien unter dem Einfluss verschiedener Zersatzmittel erleiden*), PFEIFFER and HANSEN.—*Mitt. deut. landw. Ges., 1894, No. 2, pp. 14–17.*

The utilization of the nitrogen of stable manure and of green manure (*Die Ausnutzung des Stallmiststickstoffs und des Stickstoffs im Gründüng*), J. KÜHN.—*Deut. landw. Presse, 21 (1894), No. 33, pp. 323, 324; No. 34, pp. 331, 332.*

On the conservation of the nitrogen in barnyard manure (*Zur Frage der Stickstoffkonservirung im Stalldünger*), H. IMMENDORF.—*Jour. Landw., 42, No. 1, pp. 69–124.*

FIELD CROPS.

Experiments in 1893 with varieties of potatoes (*Bericht über vergleichende Anbauversuche mit verschiedenen Kartoffelsorten im Jahre, 1893*), HEINE and WESTERMEIER.—*Deut. landw. Presse, 21 (1894), No. 31, p. 305; No. 33, p. 325; No. 34, pp. 335, 336.*

Composition of barley at different stages and on plats differently manured (*Untersuchungen über die Reifungsverhältnisse der Gerste*), C. KRAUS and A. STELLWAAG.—*Ztschr. ges. Brauw., 17 (1894), p. 77; abs. in Chem. Ztg., 18 (1894), No. 30, Repert., p. 94.*

A study of the ripening of grain (*Sulla maturazione del frumento*), N. PASSERINI.—*Staz. Sper. Agr. Ital., 26 (1894), No. 2, pp. 138–150.*

Concerning the effect of deep culture (*Zur Kenntniss der Wirkungen der Tiefkultur*), C. KRAUS.—*Fühling's landw. Ztg., 43 (1894), No. 9, p. 291–295.*

Field trials with Lathyrus sylvestris (*Anbauversuche mit der Waldplatterbse, Lathyrus sylvestris*), SPIESS.—*Ztschr. landw. Ver. Hessen, 1894, No. 12, pp. 94, 95.*

HORTICULTURE.

The care of some delicate native plants (*De la culture de quelques plantes indigènes délicates*), A. ROSENSTIEHL.—*Rev. Hort., 66 (1894), No. 7, pp. 164–167; No. 8, pp. 181–186.*

Propagation of artichokes (*Œilletonnage et plantation des artichauts*), J. GÉROME.—*Rev. Hort., 66 (1894), No. 7, pp. 154, 155.*

A new bean (*Un haricot nouveau*), H. THEULIER FILS.—*Rev. Hort., 66 (1894), No. 9, pp. 205, 206.*

Horse-radish culture (*Einiges über Meerrettichkultur*), E. S. ZÜRN.—*Deut. landw. Presse, 31 (1894), No. 30, pp. 291, 292.*

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Antiquity of the cultivation of Stachys palustris (*Ancienneté de la culture du Stachys palustris*) J. NANOT.—*Rev. Hort., 66 (1894), No. 7, pp. 157, 158.*

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The identity of the "American Rambo" ("Western Beauty"?) (*Pomme Rambour d'Amerique*), E. A. CARRIÈRE.—*Rev. Hort., 66 (1894), No. 9, pp. 202, 203.*

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The grafting of vines (*Le greffage des vignes*), G. FOEX.—*Prog. Agr. et Vit., 11 (1894), No. 16, pp. 401–405.*

Results obtained in 1893 by pruning grafted vines (*Résultats obtenus en 1893 par la taille en vert des vignes gelées*), J. DUFOUR.—*Chron. Agr. Cant. Vaud, 7 (1894) No. 7, pp. 171–189.*

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Mountain ashes: classification and cultivation (*Les Sorbiers*), C. GROSDEMANGE.—*Rev. Hort., 66 (1894), No. 7, pp. 158–161.*

An undescribed form of buds of the silver fir (*Une forme non décrite de bourgeon dans le sapin argenté*), J. GODFRIN.—*Bul. Soc. Bot. France, 41 (1894), No. 2, pp. 127–129.*

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The perennity of mycelium (*La perennité du mycelium*), E. ROSE.—*Bul. Soc. Mycol. France, 10 (1894), No. 2, pp. 94–97.*

Concerning some parasitic fungi of the Mediterranean region (*Beitrag zur Kenntniss einiger parasitischer Pilze des Mittelmeergebiets*), P. MAGNUS.—*Ber. deut. bot. Ges., 12 (1894), No. 3, pp. 84–88.*

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The sclerotium disease of the alpine rose (*Die Sclerotienkrankheit der Alpenrosen, Sclerotinia rhododendri*).—*Ber. schweiz. bot. Ges., 1894, No. 4; abs. in Bot. Centbl. 58 (1894), No. 4, pp. 138, 139.*

The ananas or pineapple disease of sugar cane, F. A. F. C. WENT.—*Sugar Cane, 26 (1894), No. 298, pp. 247, 248.*

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On the parasitism of a species of Botrytis (*Sur le parasitisme d'une espéce de Botrytis*), L. MANGIN.—*Compt. Rend., 118 (1894), No. 16, pp. 882–884.*

Investigations on Glœosporium thumeni, G. nanoti, Pestalozzia brevipes, and Discolla pirina (*Travaux du laboratoire de pathologie végétale*), PRILLIEUX and DELACROIX.—*Bul. Soc. Mycol. France, 10 (1894), No. 2, pp. 82–87.*

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The genus Ravenelia (*Die Gattung Ravenelia*), P. DIETEL.—*Hedwigia, 33 (1894), No. 2, pp. 49–69.*

Note on Trametes hispida and T. trogii (*Note sur les Trametes hispida et T. trogii*), J. GUILLEMONT.—*Bul. Soc. Mycol. France, 10 (1894), No. 2, pp. 73, 74.*

The treatment for black rot (*Traitement du Blackrot*), A. CARRÉ.—*Prog. Agr. et Vit., 11 (1894), No. 16, pp. 408–413.*

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The circulatory system of Dreissensia polymorpha (*Sur l'appareil circulatoire du Dreissensia polymorpha*), TOURENG.—*Compt. Rend., 118 (1894), No. 17, pp. 929, 930.*

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Bombylids parasitic on grasshoppers, with notes on the life history (*Les Diptéres parasites des Acridiens, les Bombylides. Hypnodie larvaire et métamorphoses avec stade d'activité et stade de repos*), K. D'HERCULAIS.—*Compt. Rend., 118 (1894), No. 17, pp. 926–929.*

Recent studies on Lachnidium acridorium, a fungus parasite of crickets (*Nouvelles études sur le Lachnidium acridorium, champignon parasite du criquet*), A. GIARD.—*Rev. Internat. Vit. et Oenol., 1 (1894), No. 2, pp. 84–86.*

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ANIMAL PHYSIOLOGY.

Preliminary remarks on the dissociation of albuminoids and the formation of urea in the body (*Quelques remarques préliminaires de le désassimilation des albuminoïdes et la formation de l'urée dans l'économie*), A. GAUTIER.—*Compt. Rend., 118 (1894), No. 17, pp. 902–907.*

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Effect of adding phosphate and carbonate of lime to food on the increase in live weight (*Tierphysiologische Untersuchungen, II*), J. NEUMANN.—*Jour. Landw., 42, No. 1, pp. 33–67.*

Effect of taking the food in one or in several portions (*Ueber den Einfluss einmaliger oder Fraktionierter Nahrungsaufnahme auf den Stoffverbrauch*), I. MUNK.—*Centbl. med. Wiss., 32, pp. 193–195; abs. in Chem. Centbl., 1894, I, No. 16, p. 777.*

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Digestibility and nutritive value of margarin as compared with natural butter, A. JOLLES.—*Abs. in Chem. Ztg., 18 (1894), No. 34, Repert., p. 104.*

The occurrence of poisonous leguminous seed in Indian peas, J. A. VOELCKER.—*Analyst, 19 (1894), May, pp. 102–107.*

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On ground sunflower-seed cake (*Ueber Sonnenblumenkuchenmehl*), L. GRÜNHUT.—*Chem. Ztg., 18 (1894), No. 31, p. 566.*

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Inoculation experiments for the prevention of anthrax, A. EDINGTON.—*Agr. Jour. Cape Colony, 7 (1894), No. 8, pp. 188, 189.*

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DAIRYING.

Milk with a bad odor and its cause (*Ueber einen Milchfehler und seine Ursache*), W. THÖRNER.—*Chem. Ztg., 18 (1894), No. 33, pp. 607–609.*

A case of salty milk (*Ein Fall von salziger Milch*), PICH-POLÁK.—*Oesterr. Molk. Ztg., 1 (1894), No. 4, p. 37.*

Determination of acidity of milk (*Determinazione del grado di acidi del latte*), SCHAFFER, Transl. by N. BOCHICCHIO.—*Staz. Sper. Agr. Ital., 26 (1894), No. 2, pp. 164–167.*

The volatile fatty acids of butter as determined during twelve successive months (*Determinazione periodica degli acidi grossi volatili nei burri prodotti durante un' intera annato*), L. CANTONI and L. CARCANO.—*Staz. Sper. Agr. Ital., 26 (1894), No. 2, pp. 131–137.*

The cause of bitter cheese (*Die Ursache des "Bitterwerdens" des Käses*), E. VON FREUDENREICH.—*Molk. Ztg., 8 (1894), No. 16, pp. 230, 231.*

Bacteriology and microbiology in their bearing on dairying (*Ueber die Bakteriologie und Mikrobiologie in ihrer Anwendung auf das Molkereigewerbe*), L. ADAMETZ.—*Oesterr. Molk. Ztg., 1 (1894), No. 4, pp. 34, 35.*

Report for 1893 of the dairy institute at Hameln, Germany (*Bericht über die Thätigkeit und Einrichtung des Milchwirtschaftlichen Instituts zu Hameln für das Jahr 1893*), P. VIETH.—*Abs. in Molk. Ztg., 8 (1894), No. 17, p. 270.*

Report for 1893 of the dairy experiment station at Freiburg (*L'activité de la Station laitiére de Fribourg en 1893*), E. DE VEVEY.—*Freiburg: Imprim. et libr. de l'oeuvre de Saint-Paul, 1894, pp. 57.*

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The water-soluble carbohydrates of malt (*Die wasserloslichen Kohlehydrate des Malzes*), G. DÜLL.—*Ztschr. ges. Brauw., 17, pp. 79-81; abs. in Chem. Centbl., 1894, I, No. 16, p. 788.*

Report on experiments in wine-making in 1892 (*Rapport sur des expériences de vinification en 1892*), E. KAYSER.—*Bul. Min. Agr. France, 13 (1894), No. 1, pp. 67-79.*

Researches on mannited wines (*Recherches sur les vins mannités*), U. GAYON.—*Bul. Min. Agr. France, 13 (1894), No. 1, pp. 118-124.*

AGRICULTURAL ENGINEERING.

An elastic draft hitch and dynamometer (*Stassfänger mit Kraftmesser*).—*Fühling's landw. Ztg., 43 (1894), No. 4, pp. 125, 126.*

Tests of farm implements and miscellaneous machines in 1891 (*Rapport sur les expériences effectuées à la station d'essais de machines agricoles*), RINGLEMANN.—*Bul. Min. Agr. France, 13 (1894), No. 1, pp. 79-118.*

EXPERIMENT STATION NOTES.

Michigan Station.—The State board of agriculture at its last meeting discontinued the substation at Grayling, as a five years' trial had failed to demonstrate that the sandy pine plains of that region could be made profitable farm land.

Ohio Station.—The Ohio legislature at its last session provided for the redemption by the State of the bonds issued by Wayne County ($85,000 in amount) to secure the location of the station under a law which has been declared unconstitutional; and also appropriated to the station for the construction of buildings $40,000, and for other purposes, $4,000, these appropriations to be available during the two calendar years 1894 and 1895.

F. J. Falkenbach, chemist, is no longer connected with the station.

Purdue University.—In view of the work that has already been accomplished, and of the contracts that have been entered into, the trustees are able to announce that the working laboratories recently destroyed by fire will be completed, and that every machine, tool, and piece of apparatus formerly in the laboratories and necessary to carry on the instruction and practice provided for in the catalogue will be in place and ready for use before September 14, 1894.

Rhode Island College.—On April 19 the State legislature passed an act authorizing the State treasurer to pay to Brown University the sum of $40,000, in consideration of which the university was to make over to the State the original grant of 1862, and to withdraw from the United States Supreme Court its suit for the Morrill fund. This has been done, and the institution at Kingston now stands as the Agricultural and Mechanical College of Rhode Island, with adequate means of support on a college basis. By means of this addition to its resources the college will be enabled to greatly increase its facilities for instruction, adding machinery and tools to its mechanical outfit and stock, and a dairy to its agricultural department, as well as to enlarge its library.

South Carolina College.—The main building of Clemson Agricultural College, which cost $80,000, was destroyed by fire May 22. The fire originated in the museum on the third floor of the building. The large amount of combustible material made it impossible to save the building. The other buildings of the college were saved, which will enable the work of the college year to be completed. The work of reconstruction will begin at once.

Entomologist of U. S. Department of Agriculture.—C. V. Riley, for fourteen years entomologist of this Department, has resigned. L. O. Howard, formerly assistant entomologist, has been appointed his successor, and C. L. Marlatt, assistant entomologist.

Fertilizer inspection and analysis in Georgia.—In bulletins Nos. 27 and 28 of the department of agriculture of Georgia, G. F. Payne, State chemist, briefly discusses the valuation of fertilizers and reports analyses of 502 fertilizing materials, including mixed fertilizers, kainit, muriate of potash, bones, and cotton-seed meal.

Pentosans in vegetable materials.—The discovery within the past few years of pentosans as a frequent constituent of plants is a matter of special interest to agricultural chemists from the fact that it is a contribution to the knowledge of the constitution of the so-called nitrogen-free extract of feeding stuffs, which has been so imperfectly understood. Dr. G. de Chalmot, assistant chemist to the Virginia department of agriculture, has taken a prominent part in the investigation of this subject in this country, and a brief review is here given of his published papers (*Am. Chem. Jour., 15, pp. 21, 176, and 16, p. 218; and Jour. Am. Chem. Soc., 15, p. 618*).

As to the origin of pentosans in plants he lays down the general proposition that they are either a direct product of the assimilation of carbonic acid or that plants have the power of transforming hexoses into pentoses. Bayer's theory of assimilation makes the first proposition conceivable. In studying this question soluble pentoses, which could be identified as migratory substances, were sought, and these were found in the leaves of plants belonging to 30 widely different families. In the recognition of these soluble pentoses the qualitative furfurol reaction was not sufficient, since hexoses also give traces of furfurol. The furfurol was estimated quantitatively by a colorimetric method especially devised for this purpose, and was found to be in excess of that which could be yielded by the hexoses alone. Consequently the conclusion was that soluble pentoses were present. These soluble pentoses are easily diffusible through membranes permeable to water, and are not precipitated by basic acetate of lead. Hence it is believed that they are simple sugars of the formula $C_5H_{10}O_5$. They were found in the leaves and the colorless portion of the bark. The amount found was very small, ranging from 0.008 to 0.4 per cent of the green parts.

The author suggests that the pentoses may be formed and temporarily precipitated in the leaves (like starch) and gradually removed. If this were true there should be more pentosans in the leaves in the evening than in the morning. No difference was found between the absolute amounts of pentoses in similar portions of the same leaves collected in the evening and in the morning. The plants used were corn, white oak, and nasturtium (*Tropæolum*). The author concludes that pentoses are not formed as a direct product of assimilation, which is in agreement with E. Fischer's hypothesis that glyceric aldehyd is an intermediate product.

Investigations made on seeds germinating in the dark showed that in the case of peas and corn the pentosans increased during germination, and that to a certain extent these migrated from the seed to the stem and root of the plantlet. Soluble pentoses were also formed and a method had to be devised for recognizing these, owing to the presence of methyl pentoses. In the seeds of *Tropæolum majus* the pentosans materially decreased during germination, behaving in this respect like starch.

Observations on leaves, corn cobs, and oak wood indicated that pentosans increase as the plant develops, but are only formed in living organs. They do not increase in wood after it is formed, and large amounts do not appear to be essential to lignification. For instance, in the wood of *Tsuga canadensis* only 6 per cent was found. No relation could be traced between the quality of wood and the amount of pentosans present. The only general rule developed in the investigation of 27 kinds of wood was that the wood of conifers contains less pentosans than that of dicotyledonous trees, there being 10 per cent or less of pentosans in the former and from 17 to 24 per cent in the latter.

Recent works by station workers.—In *Botanical Gazette* (*vol. XIX*): On poisonous plants, B. D. Halsted, p. 200.

In *Garden and Forest* (*vol. VII*): Agricultural changes in central New York, L. H. Bailey, p. 302.

In *Science* (*vol. XXIII*): The sembling of a large native moth (*Telea polyphemus*), H. Garman, pp. 156, 157; The employment of disease-causing microbes for the destruction of field mice and similar vermin, G. McCarthy, p. 158; Importance of structural details in the study of plants, W. W. Rowlee, pp. 155, 156.

In *American Florist* (1894, No. 310): A palm leaf blight, B. D. Halsted.

In *Rural New Yorker* (May 12, 1894): Breeding of sheep, figs. 2, C. C. Georgeson, I. P. Roberts, and J. A. Craig; A potato scab experiment, R. J. Coryell; Buffalo tree hopper on apples, M. V. Slingerland.

In *Irrigation Age* (May, 1894): Experimental farming in Utah, J. W. Sanborn; (June, 1894), Simple earthen dams for irrigation reservoirs, S. Fortier.

Spraying crops: why, when, how, C. M. Weed. New York: Orange Judd Co., 2d ed., 1894, pp. 125, paper.

Fungi and fungicides, C. M. Weed. New York: Orange Judd Co., pp. 222, 90 illus., 12 mo., cloth

LIST OF PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE.

JUNE, 1894.

DIVISION OF BOTANY:

Contributions from the U. S. National Herbarium, vol. III, No. 2.

Bulletin No. 15.—The Russian Thistle.

OFFICE OF EXPERIMENT STATIONS:

Experiment Station Record, vol. V, No. 10.

DIVISION OF STATISTICS:

Report No. 116 (new series), June, 1894—Report of Statistician.

DIVISION OF VEGETABLE PATHOLOGY:

Bulletin No. 17.—Peach Yellows and Peach Rosette.

WEATHER BUREAU:

Monthly Weather Review, April, 1894.

Miscellaneous Report.—Report of Wrecks which Occurred on the Great Lakes from December 17, 1885, to November 15, 1893.

OFFICE OF ROAD INQUIRY:

Bulletin No. 5.—Information Regarding Road Materials and Transportation Rates in Certain States West of the Mississippi River.

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DIVISION OF ACCOUNTS:

Regulations Governing Transactions with the U. S. Department of Agriculture, with Extracts from the Revised Statutes, Decisions of Comptrollers, etc.

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Seventeenth Annual Report, 1893.

STORRS AGRICULTURAL EXPERIMENT STATION:
Sixth Annual Report, 1893.

AGRICULTURAL EXPERIMENT STATION OF THE UNIVERSITY OF ILLINOIS:
Bulletin No. 33, June, 1894.—The Chinch Bug in Illinois, 1894; Alkaline Tablets for Testing the Acidity of Cream; Certified Tests of Dairy Cows.

KANSAS AGRICULTURAL EXPERIMENT STATION:
Bulletin No. 46, May, 1894.—Rusts of Grain, II.

MASSACHUSETTS STATE AGRICULTURAL EXPERIMENT STATION:
Bulletin No. 52, June, 1894.—Meteorological Summary; Fertilizer Analyses.

HATCH EXPERIMENT STATION OF THE MASSACHUSETTS AGRICULTURAL COLLEGE:
Meteorological Bulletin No. 65, May, 1894.

MONTANA AGRICULTURAL EXPERIMENT STATION:
Bulletin No. 1, March, 1894.—Organization; Announcements.
Bulletin No. 2, May, 1894.—Smuts of Wheat, Oats, and Barley.

NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION:
State Weather Service Bulletin No. 55, April 30, 1894.—Meteorological Summary for April, 1894.

OHIO AGRICULTURAL EXPERIMENT STATION:
Bulletin No. 52, December, 1893.—Meteorological Summary for 1893.
Bulletin No. 53, March, 1894.—Field Experiments with Commercial Fertilizers.
Twelfth Annual Report, 1893.

SOUTH CAROLINA AGRICULTURAL EXPERIMENT STATION:
Bulletin No. 16 (new series), April, 1894.—Experiments with Tomatoes.

TEXAS AGRICULTURAL EXPERIMENT STATION:
Bulletin No. 29, December, 1893.—Effects of Cotton Seed and Cotton-seed Meal on Butter, Beef Tallow, Lard, and Sheep Suet.
Sixth Annual Report, 1893.

AGRICULTURAL EXPERIMENT STATION OF UTAH:
Bulletin No. 29, May, 1894.—Irrigation: Amount of Water to Use; Relative Feeding Values of Timothy, Lucern, and Wild Hay.
Bulletin No. 30, June, 1894.—Narrow *vs.* Wide Nutritive Rations for Horses.

AGRICULTURAL EXPERIMENT STATION OF THE UNIVERSITY OF WISCONSIN:
Bulletin No. 39, April, 1894.—Noxious Weeds.

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Miscellaneous Bulletins.—No. 1, Proceedings of Knoxville Convention of Association of Agricultural Colleges and Stations, January, 1889; No. 2, Proceedings of Washington Convention of the Association, November, 1889; No. 3, Proceedings of Champaign Convention of the Association, November, 1890. (Series discontinued.)

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The Agricultural Experiment Stations in the United States.

R. Kent Beattie

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DELAWARE—*Newark:* A. T. Neale.*

FLORIDA—*Lake City:* O. Clute.*

GEORGIA—*Experiment:* R. J. Redding.*

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IOWA—*Ames:* James Wilson.*

KANSAS—*Manhattan:* G. T. Fairchild.§

KENTUCKY—*Lexington:* M. A. Scovell.*

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MAINE—*Orono:* W. H. Jordan.*

MARYLAND—*College Park:* R. H Miller.*

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MISSOURI—*Columbia:* E. D. Porter.*

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NEW MEXICO—*Mesilla Park:* S. P. McCrea.*

NEW YORK—*Geneva:* State Station; P. Collier.* *Ithaca:* Cornell University Station; I. P. Roberts.*

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SOUTH DAKOTA—*Brookings:* L. McLouth.§

TENNESSEE—*Knoxville:* C. F. Va[illegible]

TEXAS—*College Stat*[illegible]

UTAH—*Loga*[illegible]

VERMONT—*Bur*[illegible]

VIRGINIA—*Bl*[illegible]

WASHINGT[illegible]

WEST VIR[illegible]—*Morgantown:* J. A. Myers.*

WISCONSIN—*Madison:* W. A. He[illegible]

WYOMING—*Laramie:* A. A. Johnson.*

* Director.

† President of board of direction.

‡ Assistant director in charge.

§ Chair[illegible]

|| Secret[illegible]

EXPERIMENT STATION RECORD.

VOL. V. NO. 12.

The present number completes the fifth volume of the Experiment Station Record. The list of abstracts included in this volume comprises 267 bulletins and 43 annual reports of 55 experiment stations in the United States, 67 publications of this Department, and 227 foreign articles. The total number of titles abstracted is 973, classified as follows: Chemistry, 46; botany, 42; bacteriology, 4; zoölogy, 6; mineralogy, 1; meteorology, 36; water and soils, 36; fertilizers, 72; field crops, 155; horticulture, 84; forestry, 10; seeds, 16; weeds, 8; diseases of plants, 66; entomology, 74; foods and animal production, 119; veterinary science, 18; dairying, 89; agricultural engineering, 18; technology, 4; and statistics, 69. There are also 1,514 titles of foreign articles not abstracted.

As in previous volumes, the index has been made sufficiently detailed to serve as a guide to the contents of all the publications abstracted.

The following general statistics of the experiment stations in this country may be of interest in connection with the accounts of their work presented in the Record. The figures given are for the year 1893, the period covered by most of the publications abstracted in this volume.

Agricultural experiment stations are now in operation in all the States and Territories. Excluding branch stations, the total number of stations in the United States is 55. The total income of the stations during 1893 was $950,073, of which $705,000 was received from the National Government. The stations employ 532 persons in the work of administration and inquiry. The number of officers engaged in the different lines of work is as follows: Directors, 70; chemists, 119; agriculturists, 54; horticulturists, 62; farm foremen, 25; dairymen, 7; botanists, 37; entomologists, 42; veterinarians, 26; meteorologists, 13; biologists, 11; physicists, 4; geologists, 4; mycologists and bacteriologists, 5; irrigation engineers, 4; in charge of substations, 33; secretaries and treasurers, 25; librarians, 8; and clerks, 27. There are also 25 persons classified under the head of "miscellaneous," including superintendents of gardens, grounds, and buildings, apiarists, herdsmen, etc.

INDEX OF NAMES.

INDEX OF SUBJECTS.

PUBLICATIONS OF THE OFFICE OF EXPERIMENT STATIONS.

Office of Experiment Stations issues three classes of publications for general bution:

Experiment Station Record and (2) Bulletins, which are more or less technical. he practice to send to persons applying for them one or more numbers, from they may judge of their usefulness, but not to place any names upon the ıg list until after receipt of applications on special blanks furnished by the

Farmers' Bulletins, which are brief and popular in character, and are sent on ation. These bulletins are issued as part of the general series of Farmers' ins of the Department of Agriculture.

following publications have been issued:

eriment Station Record, vol. I, 6 numbers; vol. II, 12 numbers; vol. III, 12 numnd index; vol. IV, 12 numbers, including index; vol. V, Nos. 1–11. Copies of tation and Department publications abstracted in the Record can, in many ces, be obtained on application.

etins.—No. 1, Organization and History of the Stations; No. 2, Digest of Annual ts of the Stations for 1888, in two parts; No. 3, Report of Meeting of Hortiists at Columbus, Ohio, June, 1889; No. 4, List of Station Horticulturists and e of their Work; No. 5, Organization Lists of Stations and Colleges, March, No. 6, List of Station Botanists and Outline of their Work; No. 7, Proceedings Fifth Annual Convention of the Association of American Agricultural Colınd Experiment Stations, Washington, D. C., August, 1891; No. 8, Lectures on igations at Rothamsted Experimental Station; No. 9, The Fermentations of No. 10, Meteorological Work for Agricultural Institutions; No. 11, A Compila-Analyses of American Feeding Stuffs; No. 12, Organization Lists of the Agrial Experiment Stations and Agricultural Schools and Colleges in the United June, 1892; No. 13, Organization Lists of the Agricultural Experiment Stand Agricultural Schools and Colleges in the United States, April, 1893; No. oceedings of a Convention of the National League for Good Roads, January, No. 15, Handbook of Experiment Station Work; No. 16, Proceedings of the Annual Convention of the Association of American Agricultural Colleges and ment Stations, New Orleans, Louisiana, November, 1892; No. 17, Suggestions Establishment of Food Laboratories; No. 18, Assimilation of Free Atmos-Nitrogen by White and Black Mustard; No. 19, Organization Lists of the ltural Experiment Stations and Agricultural Schools and Colleges in the States, January, 1894.

llaneous Bulletins.—No. 1, Proceedings of Knoxville Convention of Association cultural Colleges and Stations, January, 1889; No. 2, Proceedings of Washingnvention of the Association, November, 1889; No. 3, Proceedings of Champaign ition of the Association, November, 1890. (Series discontinued.)

ers' Bulletins.—No. 1, The What and Why of Agricultural Experiment Stations; llustrations of the Work of the Stations; No. 9, Milk Fermentations and their n to Dairying; No. 11, The Rape Plant; No. 14, Fertilizers for Cotton; No. uminous Plants for Green Manuring and for Feeding.

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The Agricultural Experiment Stations in the United States.